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April 15, 2019

Pam Scully
Remedial Project Manager
U.S EPA Region 4
61 Forsyth Street, SW
Atlanta, GA 30303-8960

Re: Consent Decree, LCP Chemicals Superfund Site, Brunswick, GA
Civil Action No. 2:16-cv-00112
Pre-Design Investigation Evaluation Report and Supporting Documents

Dear Ms. Scully:

The following is submitted in accordance with Sections 6 (Deliverables) and 7 (Schedule) of the Statement of Work, Appendix B to the Consent Decree referenced above:

- Pre-Design Investigation Evaluation Report, and the following supporting document:
    - Treatability Study Evaluation Report

Draft copies are provided electronically for review. Once final, two hard copies and one electronic copy on a memory disk will be provided to EPA and the Georgia EPD. Please let us know if you need anything else to help facilitate your review of these documents.

Sincerely,

Prashant Gupta
Project Coordinator

cc: EES Case Management Unit, U.S. Department of Justice (w/enclosures)
Director, Superfund Division, U.S. Environmental Protection Agency (w/enclosures)
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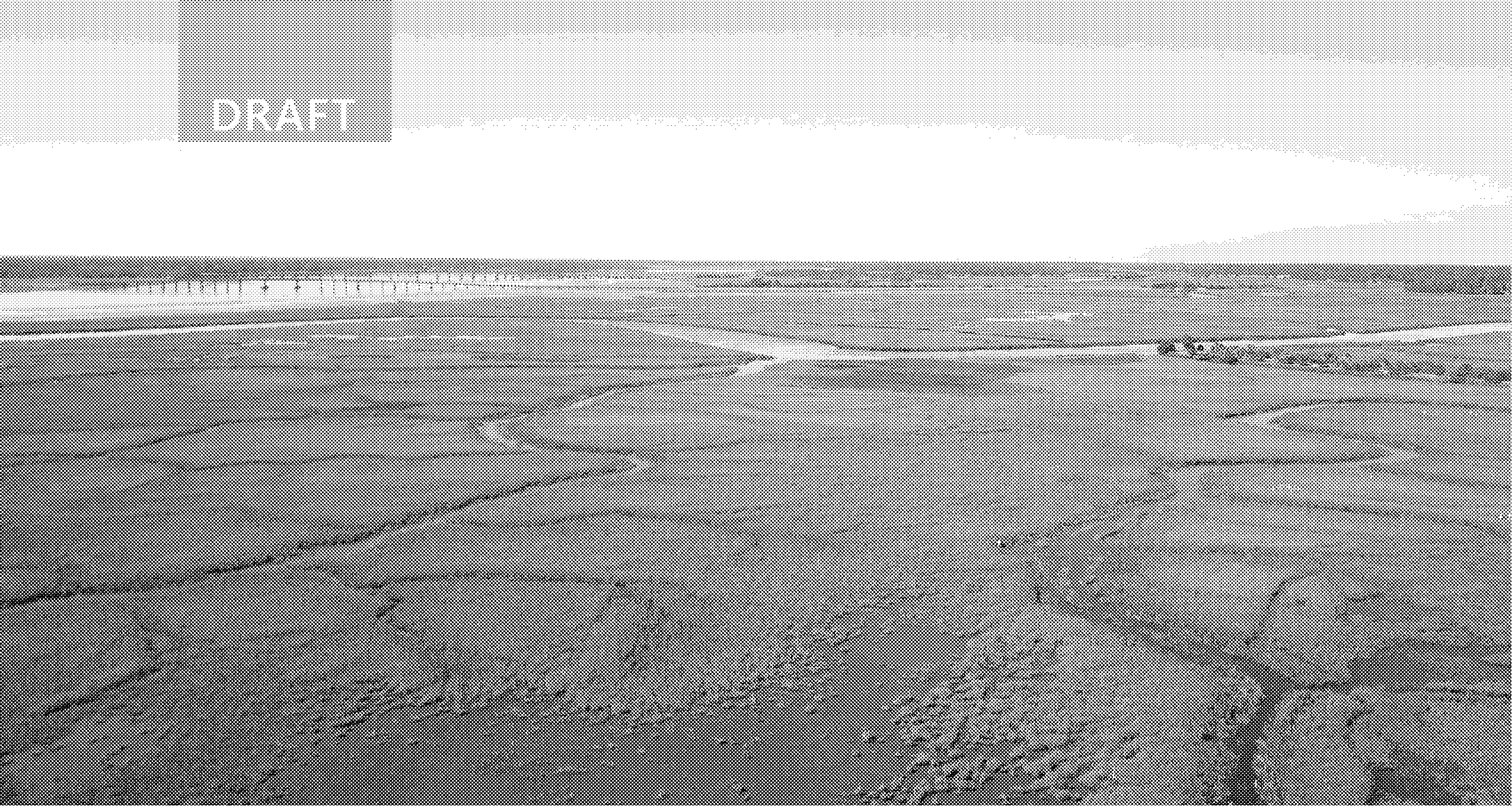

April 2019
LCP Chemicals Superfund Site Operable Unit 1

Pre-Design Investigation Evaluation Report

Prepared for Honeywell

April 2019
LCP Chemicals Superfund Site Operable Unit 1

Pre-Design Investigation Evaluation Report

Prepared for
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Project Number: 190287-02.01

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

Appendix A	Topographic and Bathymetric Survey Data Report
Appendix B	Cone Penetrometer Testing Results
Appendix C	Seepage Induced Consolidation Test Results
Appendix D	Geotechnical Sampling Laboratory Reports
Appendix E	Treatability Study Report
Appendix F	Data Validation and Laboratory Reports
Appendix G	Photolog of PDI Program

ABBREVIATIONS

Arc	Arc Surveying & Mapping, Inc.
cm	centimeter
CSM	Conceptual Site Model
CPT	cone penetration testing
DGPS	differential global positioning system
DOC	dissolved organic carbon
DQO	data quality objective
EDD	electronic data deliverable
FS	Feasibility Study
FSP	*Field Sampling Plan*
Honeywell	Honeywell International Inc.
LiDAR	Light Detection and Ranging
LCP	Linden Chemicals and Plastics
OU1	Operable Unit 1
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDDs/PCDFs	polychlorinated dibenzodioxins/polychlorinated dibenzofurans
PDI	Pre-Design Investigation
PDI Evaluation Report	*Pre-Design Investigation Evaluation Report*
PDIWP	*Pre-Design Investigation Work Plan*
PSWP	*Pilot Study Work Plan*
QA/QC	quality assurance/quality control
QAPP	*Quality Assurance Project Plan*
RDWP	*Remedial Design Work Plan*
RI/FS	Remedial Investigation/Feasibility Study
RTK	real-time kinematic
SICT	seepage-induced consolidation test
Site	Operable Unit 1 of the LCP Chemicals Superfund Site
SPME	solid-phase microextraction
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency
VST	vane shear test

1 Introduction

This *Pre-Design Investigation Evaluation Report* (PDI Evaluation Report) is submitted in accordance with Section 3.3(a) of Appendix B of the Consent Decree entered into between Honeywell International Inc. (Honeywell) and the Georgia Power Company with the U.S. Environmental Protection Agency (USEPA), *The United States v. Honeywell International Inc. et al.*, Civil Action No. 2:16-cv-00112, which was filed in the United States District Court for the Southern District of Georgia, with an effective date of July 27, 2017 (Consent Decree). The Consent Decree addresses the estuarine setting that constitutes Operable Unit 1 (OU1) of the LCP Chemicals Superfund Site located in Brunswick, Georgia (Site), which occupies approximately 760 acres immediately northwest of Brunswick, Glynn County, Georgia. This PDI Evaluation Report includes a summary of the results of the investigation and the data that will be used to support the development of the remedial design.

The following additional documents support the PDI Evaluation Report activities:

- *Pre-Design Investigation Work Plan* (PDIWP; Anchor QEA 2018a)
- *Remedial Design Work Plan* (RDWP; Anchor QEA 2018b)
- *Health, Safety, and Emergency Response Plan* (Appendix C to the RDWP)
- *Field Sampling Plan* (FSP; Appendix D to the RDWP)
- *Quality Assurance Project Plan* (QAPP; Appendix E to the RDWP)

1.1 Site Description

The Site property is located immediately northwest of Brunswick, Glynn County, Georgia (Figure 1-1) at 4125 Ross Road. The Site occupies approximately 850 acres. The Site is surrounded primarily by commercial and industrial property and is bordered by Old Jacksonville Highway (Route 303) to the north; a former county land disposal facility, a firing range, and Ross Road to the east; the Turtle River and associated marshes to the west; and a Brunswick Cellulose plant to the south.

The LCP Chemicals marsh (OU1) comprises about 760 acres of the property, consisting of approximately 662 acres of flat vegetated tidal marsh and 98 acres of tidal creeks. Former manufacturing operations at the Site were located on 121 acres of upland area, located east of the marsh. Various industries occupied the Site's uplands since the 1920s.

1.1.1 *Remedy Design*

The remedy is detailed in the Consent Decree, and includes the following components:

- Co-Location Study
- Dredge Areas
- Cap Areas
- Thin Cover Areas

- Staging and Materials Management
- Monitoring
- Securing Institutional Controls

The areas to be remediated are depicted in Figure 1-2, and the components of the remedy are further described in the following subsections.

1.1.1.1 Co-Location Study

Sampling to confirm that polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDDs/PCDFs) and Aroclor 1268 are co-located was performed to corroborate prior assumptions regarding the association with additional evidence. This study is presented in the *Revision 1 Co-location of Dioxins/Furans and Aroclor 1268* (EPS 2019). A draft summary report was submitted to USEPA on February 14, 2019, and is currently under review.

1.1.1.2 Dredge Areas

The scope of the remediation to be performed in dredge areas includes the following:

- Dredging approximately 7 acres in the marsh creeks known as the LCP Ditch and Eastern Creek to a target depth of 18 inches
- Backfilling dredged areas with approximately 12 inches of clean material
- Restoration of areas disturbed due to construction activities through replanting disturbed vegetated marsh areas with native plants, as feasible

1.1.1.3 Cap Areas

The scope of the remediation to be performed in cap areas will include capping approximately 6 acres to isolate contaminated sediments, including approximately 3 acres in Domain 3 Creek and 3 acres in Purvis Creek. Areas disturbed due to construction activities will be restored through replanting with native plants, as feasible.

1.1.1.4 Thin Cover Areas

The scope of the remediation to be performed in thin cover areas includes placement of a thin layer of clean material on approximately 11 acres of marsh to reduce contaminant exposures and enhance natural recovery. The scope of the pilot testing is presented in the *Pilot Study Work Plan* (PSWP; Appendix A to the RDWP [Anchor QEA 2018b]).

1.1.1.5 Staging and Materials Management

Support facilities (e.g., access roads, staging areas, and cap/backfill/thin cover material storage areas), as well as transport and off-site disposal of dredged sediment, will be required to implement the remedy and will be specified as part of the design. In addition, liquids generated from decontamination of equipment will also be managed during the investigation and remediation program.

1.1.1.6 Monitoring

The scope of monitoring to be conducted during construction will be specified as part of the remedial design, as indicated in the RDWP (Anchor QEA 2018b).

1.1.1.7 Securing Institutional Controls

Institutional controls, as defined in paragraph 4 of the Consent Decree, will be developed and implemented in accordance with paragraph 17 of the Consent Decree.

1.2 Project Objectives

According to Section 3.3 of Appendix B of the Consent Decree, the objective of the PDI is to address data gaps by conducting additional field investigations. Specific data quality objectives (DQOs) are presented in Section 2.

1.3 Report Organization

- Section 1 presents an overview of the project background and purpose of the PDI.
- Section 2 provides a description of the data needs and the associated DQOs for each area to be remediated.
- Section 3 describes the sampling approach and methods that were followed to meet the DQOs.
- Section 4 presents an overview of the data management program for the PDI. Additional information is provided in the QAPP (Appendix E to the RDWP [Anchor QEA 2018b]) and QAPP Addendum 1 (Appendix B to the PDIWP [Anchor QEA 2018a]).
- Section 5 presents a summary of the results from the PDI data collection program.
- Section 6 provides the list of references cited in the report.
- Appendices
  - Appendix A: Topographic and Bathymetric Survey Data Report
  - Appendix B: Cone Penetrometer Testing Results
  - Appendix C: Seepage Induced Consolidation Test Results
  - Appendix D: Geotechnical Sampling Laboratory Reports
  - Appendix E: Treatability Study Report
  - Appendix F: Laboratory Data Validation Report
  - Appendix G: Photolog of PDI Program

2 Investigation Objectives

2.1 Data Gaps and Clarifications

The Site was characterized through the collection of an extensive dataset during the Remedial Investigation/Feasibility Study (RI/FS). However, engineering data is needed to supplement the RI/FS data to complete the design of the remedy, including determining updated vegetated extents and channel boundaries. The following general types of supplemental data were collected during the PDI:

- Updated topographic and bathymetric survey data in areas targeted for remediation, as well as in support areas (e.g., areas where access roads may be constructed), to facilitate preparation of plans and specifications for contractor use and to refine vegetation extents and channel boundaries
- Geotechnical data to physically characterize sediments and subsurface soils and derive engineering soil properties for evaluations that may affect dredging methods, capping methods, and construction of temporary access roads through the marshes (e.g., slope stability, bearing capacity, and material handling properties)
- Data to support design of the isolation cap (specifically to refine input parameters to the cap model developed as part of the FS [ENVIRON and Anchor QEA 2015]), including the following:
  - Sediment type and thickness confirmation
  - Chemical characterization of sediment and porewater
- Treatability studies to evaluate methods of handling and disposal of dredged materials

DQOs for the PDI data collection activities associated with each component of the remedy are described in the following sections, as outlined in the approved PDIWP (Anchor QEA 2018a). The approach and methods followed to achieve these DQOs are presented in Section 3.

2.2 Site-Wide DQOs

Site-wide DQOs from the approved PDIWP are as follows:

- DQO 1 – Refine the horizontal extent of major tidal creek configurations and topographic details for remedial design and access purposes.
- DQO 2 – Determine topography in areas adjacent to the footprint of the remedy that may be used as support areas/access routes to evaluate site preparation needs and establish available operational areas for full-scale remediation.
- DQO 3 – Collect more detailed bathymetry within the footprint of the remedy to refine remediation volumes and establish top of sediment for removal prism development.

- DQO 4 – Collect geotechnical data to support remediation activities, including assessing subsurface conditions along potential alignments for temporary construction access roads and to support stability evaluations for access roadway designs.

2.3 DQOs for Dredge Areas

DQOs from the approved PDIWP in dredge areas are as follows:

- DQO 5 – Collect geotechnical data via vane shear tests (VSTs) and probing of sediment/soil samples to derive engineering parameters for stability evaluations of dredge cuts, to assess dredge methods and material handling procedures for dredged material, and to assess post-dredge conditions for backfill placement.
- DQO 6 – Perform a treatability study to identify appropriate handling and disposal methods for dredged materials.

2.4 DQOs for Cap Areas

DQOs from the approved PDIWP in areas to be capped are as follows:

- DQO 7 – Confirm the presence and thickness of marsh clay within the cap footprint to confirm inputs and assumptions for the cap design model.
- DQO 8 – Refine and measure contaminant concentrations in shallow sediment and porewater within the cap footprint for input into cap design modeling.
- DQO 9 – Collect geotechnical data via VSTs, probing, and sediment/soil samples to derive engineering parameters for evaluations of cap slope stability, cap lift thickness, and potential porewater expression during cap placement.

2.5 DQOs for Thin Cover Areas

DQOs from the approved PDIWP in thin cover placement areas are as follows:

- DQOs for the thin cover areas associated with the Pilot Study are presented in the PSWP and the QAPP (Appendices A and E to the RDWP [Anchor QEA 2018b]). The DQOs for the scope of work included in the PDIWP (Anchor QEA 2018a) that are relevant for the thin cover areas are addressed in the site-wide DQOs (Section 2.2).

3 Approach and Methods

3.1 Site-Wide

3.1.1 *Topographic Survey*

Topographic surveying was conducted over several areas of the Site to achieve DQOs 1 and 2. Topographic survey data was collected using a combination of Light Detection and Ranging (LiDAR) aerial survey data supplemented by topographic survey data collected directly in the marsh. This survey supplements existing topographical information at the Site and was performed in the areas depicted in Figure 3-1.

The topographic survey data was collected by Arc Surveying & Mapping, Inc. (Arc), a surveyor licensed in the state of Georgia. The LiDAR survey data was collected by Arc's subcontractor, Precision Aerial Reconnaissance, LLC. Arc combined the LiDAR and topographic survey data sets into a single, continuous topographic map of the surveyed areas.

For the LiDAR data collection, an aerial survey was conducted over the marsh using a Cessna 206 single engine aircraft, and LiDAR data was collected using a Lieca ALS70 Airborne Laser Scanner working in conjunction with a GPS receiver. Calibrated and corrected LiDAR data swaths were then collected, tiled, and auto ground classed prior to manual editing of the ground classification. Data was verified to a sampling of conventional topographic profiles throughout the data set. The topographic portion of the survey was performed using standard real-time kinematic (RTK) surveying procedures. A GPS base station was positioned on a known site control and transmitted vector corrections to roving RTK-GPS units acquiring topographic site elevations and positions of features within the site limits. After verification and processing of the LiDAR and topographic survey data, the two data sets were combined into a single topographic survey data set (Appendix A).

The resolution of the collected survey is consistent with that typically achieved with RTK-GPS systems (approximately 1 to 2 centimeters [cm] horizontal and 2 to 4 cm vertical). Additionally, the topographical survey was merged with the bathymetric survey (Section 3.1.2) to provide a contiguous Site survey.

The topographic map generated with the collected survey data is depicted in Figures 3-2a to 3-2e and included in Appendix A. The 1-foot contours have been shown on this figure to allow for visualization of the data. The finer resolution survey data will be utilized as part of the detailed design evaluations. The topographic map includes the following:

- Surface topography (1-foot contours in upland staging areas; 0.25-foot contours or smaller in marsh areas and channel banks to define surfaces)
- Bathymetry (0.25-foot contours or smaller to define surfaces)

- Structures or features (e.g., docks, piers, piles, outfalls, miscellaneous debris, overhead power lines, driveways, fencing, maintained lawn areas, paved areas, public roadways, and utilities)
- Extent of vegetation and the top of the banks of the waterbodies within the area to be mapped illustrated on aerial imagery

3.1.2 *Bathymetric Survey*

A bathymetric survey was conducted by Arc in December 2018 in the in-water portions of the remedy area to meet DQO 3. Single-beam bathymetric survey data was collected from a shallow-draft vessel, and soundings were obtained utilizing an Odom CVM Echosounder operating at a frequency of 200 kHz. Positions and water levels were obtained from an RTK GPS base station occupying survey site control and transmitting corrections to the survey vessel. Echosounder calibrations were performed at the beginning and end of each survey day. Calibrations were performed by "bar check" where transducer draft and speed of sound of water were determined. Water levels were monitored by RTK methods and verified to water levels checked by manual leveling techniques. Hydrographic data was processed with "HYPACK" where outliers were removed, and tidal data applied. Upon verification, data was imported to MicroStation to be merged with the LiDAR and topographic survey data sets.

As described in Section 3.1.1, the bathymetric survey was merged with the topographic survey to provide a contiguous Site survey. Bathymetric contours are provided at 0.25-foot intervals. The survey data is depicted in Figures 3-2a to 3-2e and Appendix A.

3.1.3 *Cone Penetration Testing*

Cone penetration testing (CPT) soundings were performed at 18 select locations throughout the Site (Figures 3-3a through 3-3d). CPT soundings were performed to meet DQO 4, to assess potential alignments for temporary construction access roads through the marsh and to assess the subsurface conditions in thin cover areas. CPT soundings were performed by ConeTec Inc. using an electronic piezocone manufactured by ConeTec. The piezocone was advanced into the soil using the hydraulic pressure of the ramset. The ramset was mounted to a low ground pressure amphibious tracked marsh buggy (Marsh Master) utilized specifically for this Site. The data collected as part of the CPT program are included on the individual plots within the CPT report (Appendix B). Soundings were advanced until refusal with penetration depths ranging from approximately 7 to 30 feet below ground surface.

CPT soundings were performed in general accordance with ASTM D5778. The test depth below ground surface, bearing (qc), sleeve friction (fs), and porewater pressure (u) were recorded in real-time during advancement of the piezocone. The soil behavior response is graphically presented on CPT plots in Appendix B. In addition, soil descriptions for varying soil layers were generated automatically by ConeTec software based on readings and the soil type behavior and included on the CPT plots (Appendix B).

In addition to the standard CPT soundings, full-flow penetrometer (ball) tests were performed at 5 of the 18 CPT locations to further assess the undrained shear strength (Su) of low strength soils. The ball attachment utilized for this project had a 60 cm^2 project plan area. For full-flow penetrometer test to be valid, the soil must flow around the ball. The five locations where full-flow penetrometer tests were performed were selected based on the anticipated soil strength and consistency determined during the initial CPT soundings. The full flow penetration test results are presented in Appendix B.

A total of 25 CPT locations were originally targeted for this investigation. However, based on the site conditions and presence of very soft materials, 18 of the 25 CPT locations could be safely accessed with equipment necessary to perform the CPT. The amphibious low ground pressure drill rig (Marsh Master) was specifically selected for this project to minimize ground disturbance and accessibility through the tidal marsh. Although the Marsh Master is specifically designed for traversing very soft and wet ground surface, the weight of the hydraulic ramset and CPT tooling made access across some of the steep banks of the channel impracticable and unsafe, and at risk of severe disturbance of the marsh and sediment surfaces. Therefore, seven of the targeted CPT locations at the western end of the Site could not be accessed (BRD-M044, BRD-M045, BRD-M048, BRD-M032, BRD-M035, BRD-M036, and BRD-M037). To supplement the data originally specified for those locations, field VSTs were manually performed at 3 locations (BRD-M036, BRD-M037, and BRD-M044) and have been included in Table 3-1.

3.2 Dredge Areas

3.2.1 *Geotechnical Testing*

VSTs and probing were conducted in the dredge areas to achieve DQO 5. VSTs were performed in general conformance with ASTM D2573 and the test instrument manufacturer's guidance (RocTest 2005), and a summary of the results are included on Table 3-1. VSTs were collected as outlined in the PDIWP; however, some locations that were intended to cross channel segments were completed as a single point rather than a transect due to the very narrow width of the channels. VSTs collected in the dredge area show peak undrained shear strengths of 41 to 92 pounds per square foot in the top 1 foot of material and 66 to 336 pounds per square foot in the deeper intervals. VSTs and probing were accessed by water—a vessel was used to navigate to the target coordinates and was held in place with spuds at each VST location shown on Figures 3-3a to 3-3c. The VST was advanced to the target depths of 1, 2, and 3 feet below the mud line. At each depth, an initial test was performed followed by a remolded test. A sediment core was collected adjacent to test locations and analyzed for index testing, moisture content, specific gravity, grain size, and Atterberg limits at each location

(Table 3-2). The results of the Atterberg limits testing provided a site-specific correction factor for the shear strengths estimated from the VSTs.

Probing was conducted along the transects outlined in Figures 3-3a to 3-3c to help achieve DQO 5 by identifying the thickness of soft sediments, presence of debris, and the general type of consolidated subsurface soils present in the proposed dredge areas. Probing in the dredge areas shows a range of penetration of 1.2 feet to greater than 5 feet with approximately half of the locations being 5 feet or greater (Table 3-3).

3.2.2 *Treatability Study*

Treatability testing was conducted on bulk sediment samples to identify appropriate means for handling, stabilizing, transporting, and disposing of dredged materials. The bulk sediment samples were prepared for on-site bench-scale sediment stabilization testing and for off-site bench-scale sediment dewatering testing. Samples for the treatability studies were collected from sample locations BRD-C014, BRD-C018, and BRD-C020 (Figures 3-3b and 3-3c), which were composite samples representing generalized conditions of larger areas within the dredge footprints.

For the on-site sediment stabilization testing, three candidate dewatering agents (Portland cement, Quicklime, and Calciment) were mixed into test piles at varying mix ratios (percent by weight of dredged sediment). Each test pile was then tested for strength properties at several times after mixing. Based on the results of the bench-scale testing, two samples were selected for waste characterization analysis; the two selected samples were based on the best combination of stabilization properties using the minimum necessary dosage. Additionally, the treatability study included elutriate testing to estimate the quality of water removed from the dredged material as part of the dewatering process and evaluate its properties for treatment or disposal.

For the off-site bench-scale dewatering testing, a portion of the bulk sediment samples, and surface water collected from near the same sample locations were shipped to Infrastructure Alternatives, Inc., to conduct rapid dewatering tests and hanging bag tests. These tests were performed to identify a polymer that facilitated sediment dewatering within geotextile tubes. After completing the hanging bag tests, waste characterization and elutriate water tests were also performed on the sediment retained in the geotextile tubes and the water passing through the geotextile tubes, respectively.

Supplemental material was also collected in Purvis Creek at locations BRD-C003 and BRD-C045 and will be held on site as archived material in the event that additional evaluations are required. Additional detail pertaining to the methods and results of the sediment treatability testing, including waste characterization and elutriate water test results, are summarized in the Treatability Study Report (Appendix E).

3.3 Cap Areas

3.3.1 *Cap Design Model Input Confirmation*

3.3.1.1 Groundwater Parameters

The Conceptual Site Model (CSM) depicted in the FS indicates that the thickness of the marsh clay is generally over 2 feet and that it may decrease near the upland areas. A reduction in thickness (or absence) of the marsh clay could affect groundwater flow characteristics beneath the cap, especially along the shoreline. A survey was performed in the area to be capped to confirm the CSM and that approximately 2 feet of marsh clay are present. A combination of probing, VSTs, and geotechnical sediment sampling was conducted to establish subsurface sediment type and thickness, as well as visual observations to evaluate potential bank discharge areas.

3.3.1.1.1 *Marsh Clay Thickness Summary*

The presence and thickness of marsh clay was evaluated by a combination of probing, VST testing, and geotechnical testing at locations along each of the transects depicted on Figure 3-3d. Field staff navigated to the transects using a differential global positioning system (DGPS) and recorded individual probe locations during the investigation. As a result of the limited width of the channel, a single probe was collected at cross sectional transects due to the limited width of the creek channel. At transects where a VST was conducted, the penetration depth of the device was used as the probing depth. Fifteen of the targeted sixteen probing transects were surveyed. CT001 could not be conducted due to elevated activity at the gun firing range directly adjacent to this area. A summary of the data associated with the marsh clay thickness evaluation has been included in Table 3-4.

3.3.1.2 Chemistry Sampling Summary

3.3.1.2.1 *Sediment Results*

To achieve DQO 8, sediment chemistry sampling was conducted to refine the concentrations of contaminants in sediment and porewater within the cap footprint (Figures 3-3a, 3-3d, and 3-3e). These data will be used to refine two inputs in the cap design model: 1) specification of sediment concentrations beneath the cap in the model; and 2) refinement of the partitioning coefficients used in the model by developing site-specific partitioning relationships. These sediment data will be used in conjunction with porewater sampling data summarized below to develop these site-specific relationships during design.

Samples were collected by manually advancing a 3-inch-diameter transparent polycarbonate core tube approximately 1 foot below the top of sediment. Following retrieval of the core, the sediment was separated into two segments representing the 0- to 6-inch and 6- to 12-inch intervals, homogenized, and placed in laboratory containers. The coordinates of the actual sampling location were recorded with a DGPS. Samples were processed as described in the sediment core sampling and processing Standard Operating Procedure presented in the FSP (Appendix D to the RDWP [Anchor QEA 2018b]). The sediment samples were submitted for laboratory analysis for mercury, polychlorinated biphenyl (PCBs), lead, polycyclic aromatic hydrocarbon (PAHs), dry bulk density, and total organic carbon (TOC) (Table 3-5). Quality assurance/quality control (QA/QC) procedures for these activities are described in Section 3.5.

3.3.1.2.2 *Porewater Results*

To achieve DQO 8, porewater chemistry sampling was also performed to refine the concentrations of contaminants in porewater within the cap footprint. These data will be used to refine two inputs to the cap design model: 1) specification of porewater concentrations beneath the cap in the model; and 2) refinement of the partitioning coefficients used in the model by developing site-specific partitioning relationships. Porewater data will be used in conjunction with sediment sampling data discussed above to develop these relationships during design. Porewater samples were obtained at locations adjacent to the sediment sampling locations (Figures 3-3a, 3-3d, and 3-3e) and were analyzed for the same constituents as the sediment samples (mercury, PCBs, lead, and PAHs), as well as dissolved organic carbon [DOC].

Porewater samples were collected using solid-phase microextraction (SPME) samplers and in situ porewater samplers (peepers). SPME samplers were used to collect samples for PCB and PAH analysis, while peeper samplers were deployed to collect samples for mercury, lead, and DOC analysis. The SPME fibers were encased in stainless steel push points and inserted into the sediment in a manner to obtain samples representative of porewater within the top 1 foot of sediment. The peepers consisted of 300 to 400 milliliter Modified Hesslein In-Situ Pore Water Samplers, made from acrylic plastic and equipped with a 0.45-micrometer nylon membrane. These samplers were deployed to obtain samples representative of porewater within the top 1 foot of sediment. Multiple peepers were required at each location to provide adequate sample volume.

The SPME samplers and peepers were left in place for approximately 30 days to allow them to equilibrate with Site porewater. Upon retrieval, the SPME fibers were cut into two sections and placed in laboratory containers. The water from each of the cells in the peepers was removed using a syringe and placed in laboratory containers in a manner to represent the 0- to 6-inch and 6- to 12-inch depth intervals, and the results are summarized in Table 3-6.

3.3.2 *Geotechnical Explorations and Testing*

3.3.2.1 Summary of Investigations

3.3.2.1.1 *Vane Shear Tests Collection Summary*

VSTs were conducted in the cap areas in South Purvis Creek and Domain 3a to achieve DQO 9. VSTs were performed in general conformance with ASTM D2573 and the test instrument manufacturer's guidance (RocTest 2005). Within the South Purvis Creek cap area, VSTs were performed at four locations that generally corresponded with probing transects (Figures 3-3a and 3-3d). Three locations encountered refusal along the transect line and could not be completed (BRD-C008, BRD-C011, and BRD-C012). Within Domain 3a cap area, VSTs were performed at 10 locations generally corresponding with probing transects. VSTs were performed at 1-foot depth increments below ground surface to a depth of 2 to 3 feet. At each VST location, a sediment core was collected and analyzed for index testing, moisture content, specific gravity, grain size, and Atterberg limits (Table 3-2).

3.3.2.1.2 *1D Odometer Consolidation Testing and SICT Summary*

To assess the consolidation characteristics of the surficial sediments within the cap areas, sediment cores were collected from seven locations. Two locations were sampled in South Purvis Creek (Figure 3-3a), and five locations were sampled in Domain 3a (Figure 3-3d). Undisturbed cores were collected using a 3-inch-diameter polycarbonate tube manually pushed into the sediment. Sediment cores collected for 1D odometer consolidation testing were capped, sealed, and labeled. To minimize sample disturbance for odometer testing, cores were kept upright to the extent possible and then specially packaged and shipped to the testing laboratory upright. Sediment core samples collected for seepage-induced consolidation testing (SICT) were collected and then placed into buckets that were sealed, labeled, and shipped to the testing laboratory.

3.4 Thin Cover Areas

3.4.1 *Geotechnical Explorations and Testing*

To achieve DQO 4, data collected from geotechnical explorations and testing will be used to define sediment characteristics and engineering properties and finalize the thin cover design. CPT locations were completed to obtain subsurface data of the thin cover areas, including the potential design of construction access roads to support placement of the thin cover material.

In addition, four supplemental sediment samples were collected in an area along the southern shoreline when the CPT rig (Marsh Master) disturbed subsurface sediments in the vicinity of BRD-M038 and sheen was observed. Supplemental surface samples were collected from four locations (BRD-C048, BRD-C049, BRD-C050, and BRD-C051) in this area to determine if there were any impacts not previously identified in this area. The samples were analyzed for mercury, PCBs, lead, and PAHs (Table 3-5a), and the locations are shown on Figure 3-3c.

3.5 Quality Assurance/Quality Control

Each sample submitted to a laboratory for analysis was collected and placed in the containers specified in the QAPP (Appendix E to the RDWP [Anchor QEA 2018b]) and QAPP Addendum 1 (Appendix B to the PDIWP [Anchor QEA 2018a]). Labelling of all samples and appropriate chain-of-custody and sample handling procedures were conducted in accordance with the unique sampling identification system and protocols outlined in the QAPP and QAPP Addendum 1. These procedures include sample custody in the field and in the laboratory.

Samples submitted to a laboratory for analysis were relinquished to the laboratory by field personnel after verifying the integrity of the sample containers. Immediately after sample collection, labeling, and logging, each sample container designated for analysis was placed into an insulated cooler with wet ice or icepacks and appropriate packing materials for shipment to the laboratory.

QA/QC samples for chemistry were collected in the field at the rate of 5% to allow evaluation of data quality. Field QA/QC samples included blind duplicates, equipment blanks, matrix spikes, and matrix spike duplicates. Details regarding the collection and analysis of these samples, as well as procedures for evaluation of QA/QC data, are presented in the QAPP (Appendix E to the RDWP [Anchor QEA 2018b]).

4 Data Management

4.1 Documentation

Data was collected and recorded using a combination of methods during this project, including the use of standardized paper forms, computer-based electronic field forms, photographic documentation, electronically recorded field measurements, and laboratory-generated data. Other related documents generated during the project include field notes and chains of custody. Original documents and electronic files have been archived in an electronic project filing system, in accordance with the Honeywell document retention policy.

4.2 Data Management Procedures

Data management procedures were established to effectively process analytical and measurement data generated during the PDI such that the relevant data are readily accessible and accurately maintained. Data collected as part of the PDI has been managed in accordance with the Data Management Plan (Appendix E to the RDWP [Anchor QEA 2018b]).

4.2.1 *Field Data*

Three general types of data were collected and recorded in the field: data to support sample collection and analysis, field measurements, and field observations. Data generated in the field has been recorded either electronically or on hard copy forms. The following general steps were followed to manage the field data: 1) review of field data for accuracy and completeness; 2) review of field data against planned activities and project standards; 3) processing of field-related data; and 4) filing/archiving of field data. Naming conventions to identify unique locations and samples (including field quality control samples) and procedures for managing the data have been defined in the QAPP (Appendix E to the RDWP [Anchor QEA 2018b]) and QAPP Addendum 1 (Appendix B to the PDIWP [Anchor QEA 2018a]).

Sampling data recorded in the field was loaded into the database using a field electronic data deliverable (EDD) formatted file. After data quality review of field information was performed, EDDs were prepared from field databases or forms and loaded into the project database in accordance with the QAPP (Appendix E to the RDWP [Anchor QEA 2018b]) and QAPP Addendum 1 (Appendix B to the PDIWP [Anchor QEA 2018a]). Items included in the field EDDs are as follows:

- Sampling location information (e.g., sample identifier and coordinates [in the appropriate project coordinate system])
- Sampling method
- Boring/coring information (e.g., date/time, technique, driller, geologist, depths, recoveries, and lithology)

- Sample information (e.g., depth[s], sample type, and, if a duplicate, the associated normal parent sample)
- Field and sample-related observations

Other types of electronic field data that were collected (e.g., bathymetry and topography, and photographs) have been saved electronically and managed as part of the project files.

4.2.2 *Analytical Data*

Analytical chemistry results have been provided by the project laboratories in EDD formats. Verification of EDD formatting and completeness was performed, and each of the data packages were reviewed and validated in accordance with the procedures specified in the QAPP (Appendix E to the RDWP [Anchor QEA 2018b]) and QAPP Addendum 1 (Appendix B to the PDIWP [Anchor QEA 2018a]). Electronic versions of field and laboratory data collected during the PDI were entered into a centralized project database (EQuIS). Bathymetry, topography, CPT, and VST results will not be stored in the database, but instead stored in the project files associated with the design.

4.3 Quality Assurance, Analysis, and Reduction

Data management and project staff have reviewed the project data using the following general procedures outlined in the PDIWP (Anchor QEA 2018a):

- Review field notes/logs
- Verify field coordinates with GIS group
- Record-by-record review of hard copy or electronic data transmittals from laboratories or data validators against the records loaded in the database (referred to as "back-checking") for 100% of validated results and 10% of unvalidated results
- For data transmitted through third-parties (other than project laboratories), 5% to 10% of the data records will be checked against data transmittals to verify that records were loaded properly
- For calculated or reported (by others) analyte totals, hand calculations will be performed on subsets of data to verify the totaled values

Evaluations of the sample results have been conducted in accordance with the PDIWP (Anchor QEA 2018a), including elements outlined in the QAPP (Appendix E to the RDWP [Anchor QEA 2018b]) and the QAPP Addendum 1 (Appendix B to the PDIWP [Anchor QEA 2018b]).

5 Results and Recommendations

5.1 Site-Wide

5.1.1 *Topographic and Bathymetric Survey*

The contiguous site survey data have met the objectives set forth in DQOs 1, 2, and 3 and will be used in the design to examine tidal creek configurations, evaluate potential support areas and access routes, and utilize current bathymetric data to aid in remediation volume calculations and design of removal prisms. Survey data will be utilized to refine existing estimates from RI/FS evaluations, evaluate potential secondary staging and access points, and will form the basis for construction drawings to implement the remedy.

5.1.2 *Construction Access Roads*

CPT data was collected throughout the marsh in thin cover areas and potential access route locations and has met the requirements outlined in DQO 4. The CPT program collected data up to approximately 30 feet deep and observed mainly silts, clays, and fine sands consistent with previous explorations in the marsh. This data will be used in the design to characterize subsurface conditions along potential alignments for temporary construction access roads and to support stability evaluations for access roadway design.

5.2 Dredge Areas

5.2.1 *Geotechnical Testing*

The geotechnical testing program conducted for the dredge areas outlined in the PDIWP (Anchor QEA 2018a) collected data that met the requirements of DQO 5. The VST conducted in these areas, along with the probing results, will be used during design for stability evaluations of dredge cuts, to assess dredge methods and material handling procedures for dredged material, and to evaluate post-dredge conditions for backfill placement. Geotechnical data collected in these areas indicate the presence of soft, fine grained, high plasticity sediments.

5.2.2 *Treatability Study*

Based on the results of the stabilization bench-scale testing and the dewatering testing, either method can be used to effectively manage dredged sediments. Stabilized sediment from the bench-scale tests were effectively stabilized by all three candidate dewatering agents (Portland cement, Quicklime, and Calciment) at concentrations as low as 5% by weight with no free liquids present after 1 day of cure time. Sediment dewatering tests identified a polymer (FLOPAM A-63609) that would provide the necessary dewatering performance if geotextile dewatering methods were used during the project. Waste characterization sampling of both stabilized and dewatered sediments indicated that Toxicity Characteristic Leaching Procedure levels in the sediment managed via either method were below toxicity characteristic concentrations thresholds and are not anticipated to require specialty disposal.

5.3 Cap Areas

5.3.1 *Cap Design Model Input Confirmation*

5.3.1.1 Groundwater Parameters

Previous investigations at the Site have indicated the potential presence of bank discharge or seeps within the vicinity of the Domain 3 cap area. A visual inspection of the shoreline was performed along the extent of the cap area and confirmed that conditions in this area are consistent with previous observations documented during the approved RI and FS (Environ and Anchor QEA 2015). These conditions will be included as considerations that will be evaluated during design of the cap for this area.

5.3.1.1.1 *Marsh Clay Confirmation Survey*

Data collected from the probing survey, VST, and geotechnical analysis confirms the presence of at least 2 feet of clay at almost every location within the cap footprint in Domain 3. Locations where probing or VST investigations encountered refusal prior to achieving 2 feet were anticipated to be the result of debris or other influences and not indicative of a lack of suitable clay, with the exception of one location where sand or fill material was observed. The average depth of clay throughout this area was approximately 3.5 feet and corresponds to the CSM depicted in the FS. The data collected as part of this program provides adequate information to address DQO 7, including confirmation of the presence and thickness of marsh clay within the Domain 3 cap footprint that will be used to support the cap modeling evaluations conducted during the design.

5.3.1.2 Summary of Chemistry Data

5.3.1.2.1 *Sediment Results*

Sediment chemistry data collected as part of the PDI program met the objectives outlined in DQO 8 to refine and measure contaminant concentrations in shallow sediment within the cap footprint. These data will refine inputs as part of the cap model design evaluations by specifying sediment concentrations beneath the cap and refining the partitioning coefficients used in the model by developing site-specific partitioning relationships with the co-located porewater chemistry data. Concentrations of the sediments collected from the cap areas were generally within or below the range of concentrations observed during previous investigations (Table 5-1).

5.3.1.2.2 *Porewater Chemistry Results*

Porewater chemistry data collected as part of the PDI program met the objectives outlined in DQO 8 to refine and measure contaminant concentrations in shallow porewater within the cap footprint. These data will refine inputs as part of the cap model design evaluations by specifying porewater concentrations beneath the cap and refining the partitioning coefficients used in the model by developing site-specific partitioning relationships with the co-located sediment chemistry data. Concentrations of the porewater data collected from the cap areas were generally within or below the range of concentrations assumed for cap evaluations during the FS.

5.3.2 *Geotechnical Explorations and Testing*

The VST, 1D odometer consolidation test, and SICT programs collected data throughout the cap areas and provided the information required to address DQO 9 that will be used to evaluate cap slope stability, cap lift thickness, and potential porewater expression during cap placement. The results from each of these testing programs were generally as expected and consistent with the soft marsh sediments that have been observed during previous investigations.

5.4 Thin Cover Areas

Data collected for the thin cover areas includes information associated with site-wide DQOs 1, 2, and 3 discussed in Section 5.1, as well as CPT data collected to address DQO 4. This data will be used in the design to characterize subsurface conditions along potential alignments for temporary construction access roads and to support stability evaluations for access roadway design. Supplemental sampling was also conducted in the southern portion of Domain 2 to evaluate the disturbance of subsurface materials from the Marsh Master rig, which resulted in measurements that were within the range of concentrations observed during the RI/FS program.

In addition, other DQOs for the thin cover areas have been included as part of the PSWP (Appendix A to the RDWP [Anchor QEA 2018b]) and will be addressed in a subsequent report following collection of data for the pilot study monitoring program.

6 References

Anchor QEA (Anchor QEA LLC), 2018a. *Pre-Design Investigation Work Plan*. Brunswick Honeywell Site. Prepared for Honeywell. October 2018.

Anchor QEA (Anchor QEA, LLC), 2018b. *Remedial Design Work Plan*. Brunswick Honeywell Site. Prepared for Honeywell. April 2018.

ENVIRON (ENVIRON International Corporation) and Anchor QEA, 2015. *Feasibility Study*. LCP Chemical Superfund Site, Operable Unit No. 1 (Estuary), Brunswick, Georgia. July 2015.

EPS (Environmental Products and Services), 2019. *Revision 1 Co-location of Dioxins/Furans and Aroclor 1268*. LCP Chemical Superfund Site, Operable Unit No. 1 (Estuary), Brunswick, Georgia. February 2019.

RocTest, 2005. *Instruction Manual: Soil Settlement Gage Model SSG*. RocTest Limited.

USEPA (U.S. Environmental Protection Agency), 2015. Record of Decision. Summary of Remedial Alternatives Selection. LCP Chemicals Site, Brunswick, Glynn County, Georgia. Operable Unit 1 – Marsh CERCLIS Id: GAD099303182. Prepared By: U.S. Environmental Protection Agency, Region 4, Atlanta, Georgia. September 2015.

USEPA and Honeywell, 2017. Consent Decree for Remedial Design and Remedial Action at Operable Unit One of the LCP Chemicals Superfund Site, Civil Action No. 2:16-cv-00112. Filed July 29, 2016.

Tables

Table 3-1
Field Vane Shear Test Summary

Location	Date and Time	Northing	Easting	Datum	Depth Below Mudline (feet)	Peak Undrained Shear Strength (psf)	Residual Undrained Shear Strength (psf)
BRD-C001	12/13/2018 13:01:00	432292.67	858680.16	NAD83GAE	1	71	20
					2	102	10
					3	255	82
BRD-C002	12/13/2018 13:25:00	432273.75	858852.06	NAD83GAE	1	112	20
					2	214	10
					3	204	61
BRD-C006	12/13/2018 14:25:00	432229.40	859033.89	NAD83GAE	1	41	0
					2	92	0
					3	224	10
BRD-C007	12/13/2018 14:55:00	432202.37	859154.51	NAD83GAE	1	71	10
					2	127	36
					3	112	20
BRD-C008	12/13/2018 15:20:00	432321.14	859559.16	NAD83GAE	--	--	--
BRD-C011	12/13/2018 15:30:00	432410.94	859604.74	NAD83GAE	--	--	--
BRD-C012	12/13/2018 15:40:00	432498.15	859624.78	NAD83GAE	--	--	--
BRD-C013	12/11/2018 13:22:00	432471.45	859949.23	NAD83GAE	1	71	31
					2	173	51
					3	163	61
BRD-C015	12/11/2018 12:48:00	432396.34	860433.62	NAD83GAE	1	41	10
					2	194	51
					3	143	61
BRD-C016	12/11/2018 12:07:00	432165.22	860251.08	NAD83GAE	1	41	20
					2	102	20
					3	336	173
BRD-C017	12/11/2018 11:17:00	431828.79	860393.80	NAD83GAE	1	92	20
					2	194	61
					3	275	61
BRD-C019	12/11/2018 10:35:00	431381.01	860454.83	NAD83GAE	1	92	25
					2	92	20
					3	66	15
BRD-C023	12/15/2018 10:21:00	433726.45	861507.17	NAD83GAE	1	87	10
					2	285	31
BRD-C024	12/15/2018 10:53:00	433576.69	861407.77	NAD83GAE	1	51	0
					2	133	10
BRD-C025	12/15/2018 11:23:00	433377.31	861418.19	NAD83GAE	1	51	0
					1.5	285	31
BRD-C028	12/16/2018 09:20:00	433322.24	861352.64	NAD83GAE	1	41	10
					2	112	10
					3	61	10
BRD-C029	12/14/2018 10:48:00	433236.56	861469.48	NAD83GAE	1	61	0
					2	163	41
					3	234	41
BRD-C030	12/10/2018 15:30:00	433245.88	861646.77	NAD83GAE	1	--	--
					2	71	51
					3	122	51
BRD-C032	12/10/2018 16:00:00	433205.28	861760.80	NAD83GAE	1	76	15
					2	387	107
BRD-C034	12/11/2018 16:45:00	433105.56	861660.54	NAD83GAE	1	66	0
					2	20	0
BRD-C036	12/11/2018 17:10:00	432919.62	861638.98	NAD83GAE	1	0	0
					2	10	0
					1	24	9
					2	13	5
BRD-C038	12/15/2018 09:40:00	432818.76	861630.16	NAD83GAE	1	127	10
					2	143	0

Table 3-1
Field Vane Shear Test Summary

Location	Date and Time	Northing	Easting	Datum	Depth Below Mudline (feet)	Peak Undrained Shear Strength (psf)	Residual Undrained Shear Strength (psf)
BRD-C040	12/16/2018 09:56:00	433496.66	861878.03	NAD83GAE	1	122	10
					2	112	20
					3	173	10
BRD-C042	12/14/2018 11:27:00	433333.90	861801.19	NAD83GAE	1	41	0
					2	112	0
					3	306	20
BRD-C047	12/13/2018 11:15:00	435045.50	860506.81	NAD83GAE	1	183	10
					2	153	51
					3	133	31
BRD-M044	12/11/2018 16:15:00	433079.84	861623.18	NAD83GAE	1	--	--
					2	61	10
					4	97	46
					5	112	41
					6	168	51
					7	143	56
BRD-M037	01/15/2019 15:47:00	430758.45	860784.23	NAD83GAE	1	38	8
					2	50	5
					3	5	0
					4	71	0
					5	153	41
					6	153	51
BRD-M036	01/15/2019 15:59:00	430679.5	860787.91	NAD83GAE	1	50	5
					2	42	2
					3	40	0
					4	92	15
					5	133	20
					6	117	31

Notes:
BRD-C008, BRD-C011, and BRD-C013 were not sampled due to hard bottom sediments.
BRD-M044 test results at 1-ft are void due to root mat.

Table 3-2
Geotechnical Data Summary

Exploration ID	Sample ID	Sample Depth		Soil Classification		Moisture Content (ASTM D2216)	Atterberg Limits (ASTM D4318)				Particle Size (ASTM D422)			Specific Gravity (ASTM D854)
		Top	Bottom	USCS	General Soil Description		Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index (%)	Percent Gravel (%)	Percent Sand (%)	Percent Fines (%)	
BRD-CO23	0- 1.85-181215	0.0	1.85	CH	Fat Clay with Sand (CH)	127.5%	133	39	94	0.9	0.0	21.6	78.4	2.53
BRD-CO24	0- 1.9-181215	0.0	1.90	CH	Fat Clay with Sand (CH)	220.0%	202	41	161	1.1	0.1	15.2	84.7	2.48
BRD-CO25	0- 1.6-181215	0.0	1.60	CH	Sandy Fat Clay (CH)	116.6%	99	20	79	1.2	0.0	44.5	55.5	2.63
BRD-CO28	0- 1.8-181216	0.0	1.80	CH	Fat Clay with Sand (CH)	210.9%	147	31	116	1.6	1.5	26.2	72.3	2.77
BRD-CO38	0- 1.4-181215	0.0	1.40	CH	Sandy Fat Clay (CH)	170.2%	127	29	98	1.4	0.0	32.5	67.5	2.56
BRD-CO40	0- 1.5-181216	0.0	1.50	CH	Sandy Fat Clay (CH)	171.3%	171	38	61	2.2	0.7	49.3	50.0	2.34
BRD-M037	0- 3.15-190117	0.0	3.2	CH	Fat Clay (CH)	246.1%	215	40	175	1.2	0.0	1.8	98.2	2.42
BRD-C001	0- 1.5-181213	0.0	1.5	CH	Fat Clay (CH)	188.0%	205	52	153	0.9	0.0	1.6	98.4	2.53
BRD-C002	0- 1.5-181213	0.0	1.5	CH	Fat Clay (CH)	165.2%	166	50	116	1.0	0.0	13.5	86.5	2.57
BRD-C006	0- 2-181213	0.0	2.0	SC	Clayey Sand (SC)	104.5%	62	19	43	2.0	0.0	56.3	43.7	2.63
BRD-C007	0- 1.4-181213	0.0	1.4	SC	Clayey Sand (SC)	98.8%	78	28	50	1.4	0.4	55.7	43.9	2.58
BRD-C013	0- 1-181211	0.0	1.0	CH	Fat Clay (CH)	198.3%	167	52	115	1.3	3.3	4.7	92.0	2.57
BRD-C015	0- 1.7-181211	0.0	1.7	CH	Sandy Fat Clay (CH)	85.8%	98	29	69	0.8	0.0	37.6	62.4	2.58
BRD-C016	0- 1.2-181211	0.0	1.2	CH	Fat Clay with Sand (CH)	146.3%	142	46	96	1.0	0.0	25.0	75.0	2.63
BRD-C017	0- 1.2-181211	0.0	1.2	MH	Elastic Silt with Sand (MH)	146.6%	165	65	100	0.8	2.1	18.0	79.9	2.54
BRD-C019	0- 1.3-181211	0.0	1.3	CH	Fat Clay (CH)	197.3%	173	47	126	1.2	1.4	5.8	92.8	2.53
BRD-C029	0- 2-181214	0.0	2.0	CH	Fat Clay with Sand (CH)	177.0%	156	50	106	1.2	0.0	22.0	78.0	2.50
BRD-C030	0- 1-181210	0.0	1.0	SM	Silty Sand (SM)	75.5%	NP	NP	NP	NP	2.9	67.1	30.0	2.42
BRD-C032	0- 1-181210	0.0	1.0	SC	Clayey Sand (SC)	91.6%	58	27	31	2.1	0.0	66.8	33.2	2.40
BRD-C034	0- 1.5-181211	0.0	1.5	MH	Elastic Silt (MH)	227.5%	98	52	46	3.8	0.0	11.2	88.8	2.47
BRD-C036	0- 2-181211	0.0	2.0	CH	Sandy Fat Clay (CH)	106.4%	102	36	66	1.1	1.3	43.4	55.3	2.50
BRD-C042	0- 2-181214	0.0	2.0	CH	Fat Clay (CH)	168.9%	135	45	90	1.4	0.0	10.7	89.3	2.49
BRD-C047	0- 1.5-181213	0.0	1.5	CH	Fat Clay with Sand (CH)	123.4%	154	37	117	0.7	0.0	15.9	84.1	2.53
BRD-COMP-02	181205- GRAB-01	n/a	n/a	MH	Sandy Elastic Silt (MH)	103.4%	163	72	91	0.3	2.3	30.5	67.2	2.61
BRD-COMP-02	181205- GRAB-02	n/a	n/a	MH	Sandy Elastic Silt (MH)	90.2%	123	71	52	0.4	0.0	34.7	65.3	2.58
BRD-COMP-02	181205- GRAB-03	n/a	n/a	CH	Fat Clay with Sand (CH)	131.9%	154	44	110	0.8	0.0	21.7	78.3	2.56

Note:
NP: Sample determined to be non-plastic

Table 3-3
Summary of Probing Data Results

Location	Date	Northing	Easting	Depth of Water (feet)	Depth to Refusal (feet)	Estimated Sediment Thickness (feet)
T001A	12/13/2018	432273.604	858681.762	13.2	13.6	0.4
T001B	12/13/2018	432292.672	858680.163	6.3	> 11.3	> 5
T001C	12/13/2018	432281.225	858672.524	12.0	13.0	1.0
T002A	12/13/2018	432275.314	858853.286	6.9	11.8	4.9
T002B	12/13/2018	432263.775	858842.513	8.0	> 13.0	> 5
T002C	12/13/2018	432246.751	858839.312	11.0	15.0	4.0
T003A	12/13/2018	432245.741	859039.071	5.0	> 10.0	> 5
T003B	12/13/2018	432230.233	859034.876	6.0	12.0	6.0
T003C	12/13/2018	432219.555	859029.473	6.0	> 12.0	> 6
T003D	12/13/2018	432198.076	859152.231	6.2	> 11.2	> 5
T004A	12/13/2018	432220.565	859174.914	2.5	> 7.5	> 5
T004B	12/13/2018	432209.590	859162.048	3.7	> 8.7	> 5
T004C	12/13/2018	432198.076	859152.231	4.1	> 9.1	> 5
T005A	12/13/2018	432302.196	859601.256	6.7	6.7	0.0
T005B	12/13/2018	432321.136	859559.156	13.7	13.7	0.0
T006A	12/13/2018	432397.061	859635.102	5.6	5.6	0.0
T006B	12/13/2018	432410.935	859604.735	14.0	14.0	0.0
T007A	12/10/2018	432485.541	859674.142	4.7	5.1	0.4
T007AA	12/13/2018	432490.392	859663.738	6.0	6.0	0.0
T007B	12/10/2018	432498.154	859624.781	7.7	7.9	0.2
T007BB	12/13/2018	432498.154	859624.781	> 16	> 16	0
T008A	12/10/2018	432522.712	859745.285	8.1	11.1	3.0
T009A	12/11/2018	432457.500	859950.564	5.1	9.5	4.4
T009B	12/11/2018	432469.021	859945.437	6.2	11.3	5.1
T009C	12/11/2018	432479.854	859934.542	6.2	8.8	2.6
T009D	12/11/2018	432485.481	859938.647	5.3	9.0	3.7
T010A	12/10/2018	432470.732	860215.333	8.5	9.7	1.2
T011A	12/11/2018	432382.401	860426.493	6.0	> 11	> 5
T011B	12/11/2018	432397.370	860431.943	8.7	13.2	4.5
T011C	12/11/2018	432408.923	860435.573	6.7	11.1	4.4
T011D	12/11/2018	432416.350	860440.766	5.0	> 10	> 5
T012A	12/10/2018	432343.394	860867.536	4.7	> 9.7	> 5
T012B	12/10/2018	432365.132	860807.755	4.3	5.8	1.5
T012C	12/10/2018	432373.725	860730.766	4.6	5.8	1.2
T012D	12/10/2018	432381.219	860670.539	5.0	> 10.0	> 5
T012E	12/10/2018	432387.394	860607.084	5.2	> 10.2	> 5
T012F	12/10/2018	432394.680	860542.228	5.0	9.7	4.7
T013A	12/10/2018	432183.068	860612.457	2.8	6.8	4.0
T013B	12/10/2018	432227.757	860570.917	3.6	7.0	3.4
T014A	12/10/2018	432214.494	860522.355	7.6	9.9	2.3
T015A	12/11/2018	432158.514	860254.306	6.0	10.3	4.3

Table 3-3
Summary of Probing Data Results

Location	Date	Northing	Easting	Depth of Water (feet)	Depth to Refusal (feet)	Estimated Sediment Thickness (feet)
T015B	12/11/2018	432164.613	860249.135	7.7	11.5	3.8
T015C	12/11/2018	432171.742	860245.271	6.0	10.0	4.0
T016A	12/10/2018	432098.831	860225.737	7.0	9.4	2.4
T017A	12/10/2018	431984.185	860231.258	5.0	7.9	2.9
T018A	12/10/2018	431846.754	860176.051	4.0	7.9	3.9
T018B	12/10/2018	431868.601	860197.549	3.8	> 8.8	> 5
T019A	12/11/2018	431837.013	860396.561	5.2	9.2	4.0
T019B	12/11/2018	431829.442	860393.577	4.6	10.0	5.4
T020A	12/10/2018	431826.764	860505.816	3.3	> 8.3	> 5
T021A	12/10/2018	431684.707	860515.156	4.1	> 9.1	> 5
T022A	12/10/2018	431594.464	860387.583	4.3	> 9.3	> 5
T023A	12/10/2018	431504.438	860499.647	3.4	> 8.4	> 5
T024A	12/11/2018	431380.199	860450.420	3.5	> 8.5	> 5
T024B	12/11/2018	431384.509	860455.022	4.1	> 9.1	> 5
T024C	12/11/2018	431389.423	860459.444	3.4	> 8.4	> 5
T025A	12/10/2018	431280.259	860501.102	4.0	> 9.0	> 5
T026A	12/10/2018	431200.955	860586.608	3.7	> 8.7	> 5
T027A	12/10/2018	430772.742	860902.370	1.7	> 6.7	> 5
T027B	12/10/2018	430818.250	860923.147	3.1	7.6	4.5
T027C	12/10/2018	430857.918	860891.301	2.9	> 7.9	> 5
T027D	12/10/2018	430894.853	860850.080	2.9	> 7.9	> 5
T027E	12/10/2018	430933.147	860814.709	2.9	> 7.9	> 5
T027F	12/10/2018	430979.624	860774.715	3.1	> 8.1	> 5
T027G	12/10/2018	431026.138	860741.375	3.6	> 8.6	> 5
T028A	12/13/2018	435068.396	860531.490	9.7	12.6	2.9
T028B	12/13/2018	435026.830	860488.512	7.5	10.0	2.5
T028C	12/13/2018	435047.227	860510.699	10.8	> 15.8	> 5
T028D	12/13/2018	435103.160	860614.550	7.0	10.0	3.0
T028E	12/13/2018	435103.588	860555.742	11.3	14.7	3.4

Table 3-4
Summary of Marsh Clay Thickness Observations

Probing Transect	Probing Penetration Depth (feet)	Vane Shear Results	Grain Size
1	--	--	--
2	4.5	High Plastic, very soft	Clay with sand
3	4.3	High Plastic, very soft	Clay with sand
4	1.7	High Plastic, very soft	Sandy clay
5	3.0	High Plastic, very soft	Clay with sand
6	4.4	High Plastic, very soft	Clay with sand
7	3.0	High Plastic, very soft	Clay with sand
8	5.7	High Plastic, very soft	Clay with sand
9	3.0	Non-plastic	Silty sand
10	1.1	High Plastic, very soft	Sandy clay
11	5.8	High Plastic, very soft	Sandy clay
12	4.3	High Plastic, very soft	Clayey sand
13	2.0	High Plastic, very soft	Clayey sand
14	2.0	High Plastic, very soft	Silt
15	5.8	High Plastic, very soft	Sandy clay
16	4.1	High Plastic, very soft	Sandy clay

Notes:
Data was not collected in transect 1 due to gun range activity.
Probing penetration depth may be influenced by debris at some locations.

Table 3-5
Sediment Chemistry Data Summary

Location	Lead (mg/kg)		Mercury (mg/kg)		Aroclor 1268 (mg/kg)		Total PAH (mg/kg)	
	0-6	6-12	0-6	6-12	0-6	6-12	0-6	6-12
BRD-C004	16.9	19.4	0.5	0.5	1.3	1.2	0.9	0.8
BRD-C010	21.7	19.9	1.1	1.0	3.7	3.6	0.6	0.6
BRD-C021	82.6	202.0	8.6	9.6	8.9	22.5	1.9	1.6
BRD-C027	205.0	171.0	1.0	0.1	4.4	ND	4.5	2.0
BRD-C033	152.0	13.5	0.4	0.1	0.3	ND	22.4	0.3
BRD-C037	39.2	274.0	1.0	4.3	1.3	4.6	0.6	4.0
BRD-C039	173.0	223.5	1.1	10.6	2.0	26.0	4.7	5.1
BRD-C043	87.6	80.4	1.9	1.3	2.4	2.4	2.0	1.8
BRD-C044	26.4	26.8	1.0	1.9	2.6	9.1	0.9	0.4
BRD-C046	134.0	171.0	4.1	23.4	5.0	0.4	1.8	5.6
BRD-C048	2.1	--	0.2	--	0.2	--	0.0	--
BRD-C049	34.7	--	9.2	--	4.4	--	4.5	--
BRD-C050	26.1	--	4.9	--	2.7	--	0.5	--
BRD-C051	32.2	--	5.3	--	4.6	--	0.9	--

Notes:
Duplicates have been averaged.
Total PAH (U=1/2 max limit)

ND: non-detect
PAH: polycyclic aromatic hydrocarbon

Table 3-6
Porewater Chemistry Data Summary

Location	Lead (µg/L)		Mercury (µg/L)		Total PCBs (µg/L)		Total PAH (µg/L)	
	0-6	6-12	0-6	6-12	0-6	6-12	0-6	6-12
BRD-C004	ND	ND	0.0051	0.0002	0.0002	0.0002	0.39	0.41
BRD-C010	ND	ND	0.0074	0.0124	0.0002	0.0002	0.38	0.27
BRD-C021	ND	ND	0.0012	ND	0.0004	0.0005	0.38	0.39
BRD-C027	ND	ND	0.0018	0.0018	0.0002	0.0002	0.43	0.74
BRD-C033	ND	ND	ND	ND	0.0009	0.0006	0.60	0.61
BRD-C037	ND	ND	0.0024	ND	0.0005	0.0007	0.28	0.45
BRD-C039	ND	2.55	ND	ND	0.0007	0.0015	0.72	2.16
BRD-C043	ND	ND	0.0143	0.0025	0.0004	0.0005	0.42	0.44
BRD-C044	ND	ND	0.0096	0.0132	0.0003	0.0003	0.38	0.41
BRD-C046	ND	1.8	0.0009	ND	0.0007	0.0013	0.39	0.60

Notes:
Duplicates have been averaged.
Total PAH (U=1/2 max limit)
Total PCB Congeners (U=1/2 max limit)

µg: microgram
ND: non-detect
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl

Table 5-1
Comparison of Sediment Chemistry in Cap Areas – RI/FS to PDI

	Sediment (RI/FS)			Sediment (PDI)			Sample Counts	
Total PAH (mg/kg)	**Min**	**Average**	**Max**	**Min**	**Average**	**Max**	**RI/FS**	**PDI**
0-6 Inches	0.01 U	9.3	54.9	0.6	4.0	22.4	13	10
6-12 Inches	NA	NA	NA	0.3	2.2	5.6	0	10
0-12 Inches (RI Only)	0.09 J	3.4	17.3	NA	NA	NA	6	0

	Sediment (RI/FS)			Sediment (PDI)			Sample Counts	
Aroclor 1268 (mg/kg)	**Min**	**Average**	**Max**	**Min**	**Average**	**Max**	**RI/FS**	**PDI**
0-6 Inches	0.01 J	4.7	28.0	0.3	3.2	8.9	15	10
6-12 Inches	NA	NA	NA	0.0	7.0	26.0	0	10
0-12 Inches (RI Only)	0.02 J	2.9	14.0	NA	NA	NA	6	0

	Sediment (RI/FS)			Sediment (PDI)			Sample Counts	
Lead (mg/kg)	**Min**	**Average**	**Max**	**Min**	**Average**	**Max**	**RI/FS**	**PDI**
0-6 Inches	8.9	278.7	1590.0	16.9	93.8	205.0	14	10
6-12 Inches	NA	NA	NA	13.5	119.1	274.0	0	10
0-12 Inches (RI Only)	14.0	542.6	1200.0	NA	NA	NA	7	0

	Sediment (RI/FS)			Sediment (PDI)			Sample Counts	
Mercury (mg/kg)	**Min**	**Average**	**Max**	**Min**	**Average**	**Max**	**RI/FS**	**PDI**
0-6 Inches	0.0	2.8	20.0	0.4	2.1	8.6	15	10
6-12 Inches	NA	NA	NA	0.1	5.3	23.4	0	10
0-12 Inches (RI Only)	0.1	4.3	15.6	NA	NA	NA	6	0

Notes:
tPAH data used was U=1/2
Data includes Purvis Creek cap areas

µg: microgram
FS: Feasibility Study
PAH: polycyclic aromatic hydrocarbon
PDI: Pre-Design Investigation
RI: Remedial Investigation
tPAH: total polycyclic aromatic hydrocarbons
NA: data not available

Figures

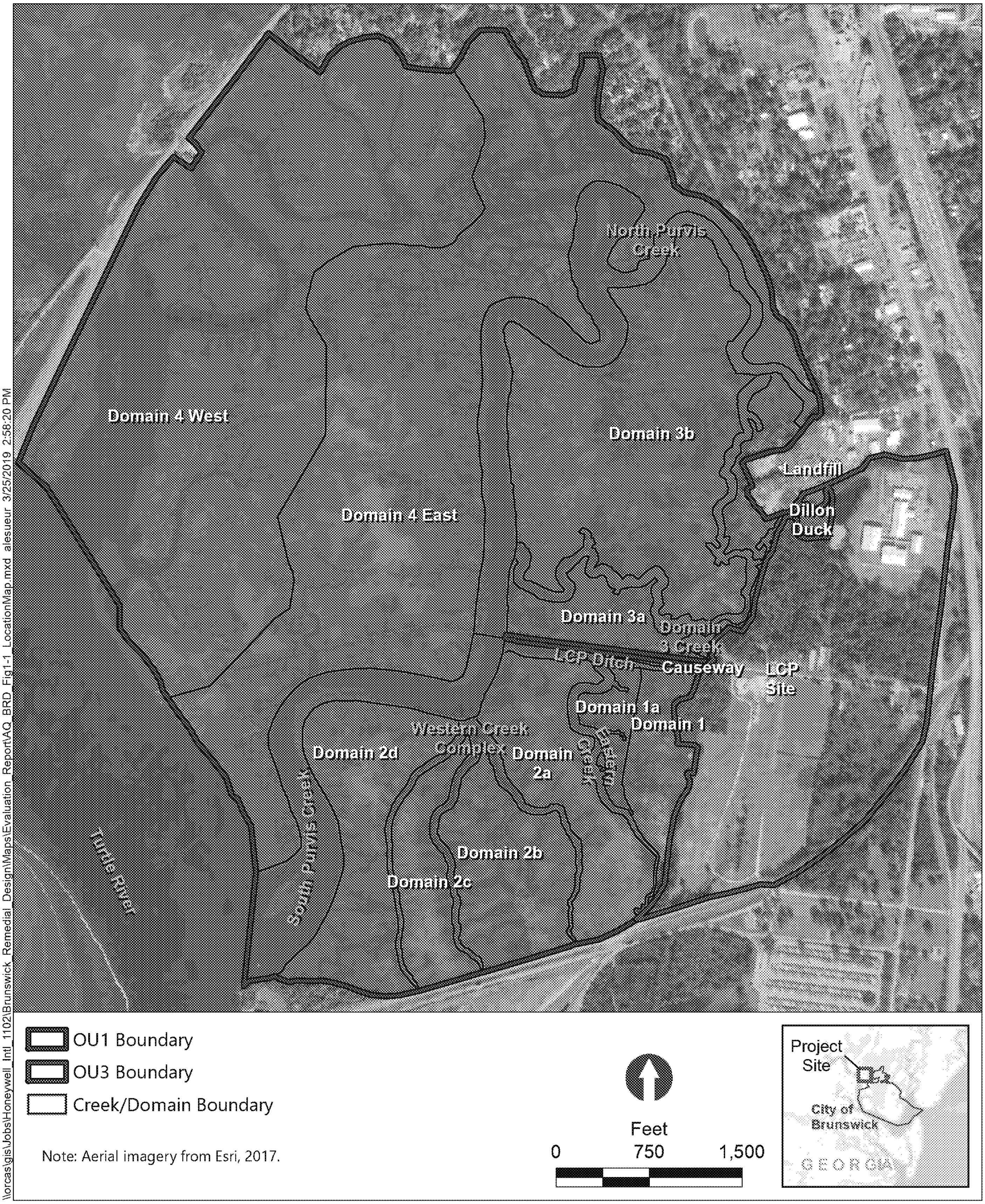


Figure 1-1
Site Location Map
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA

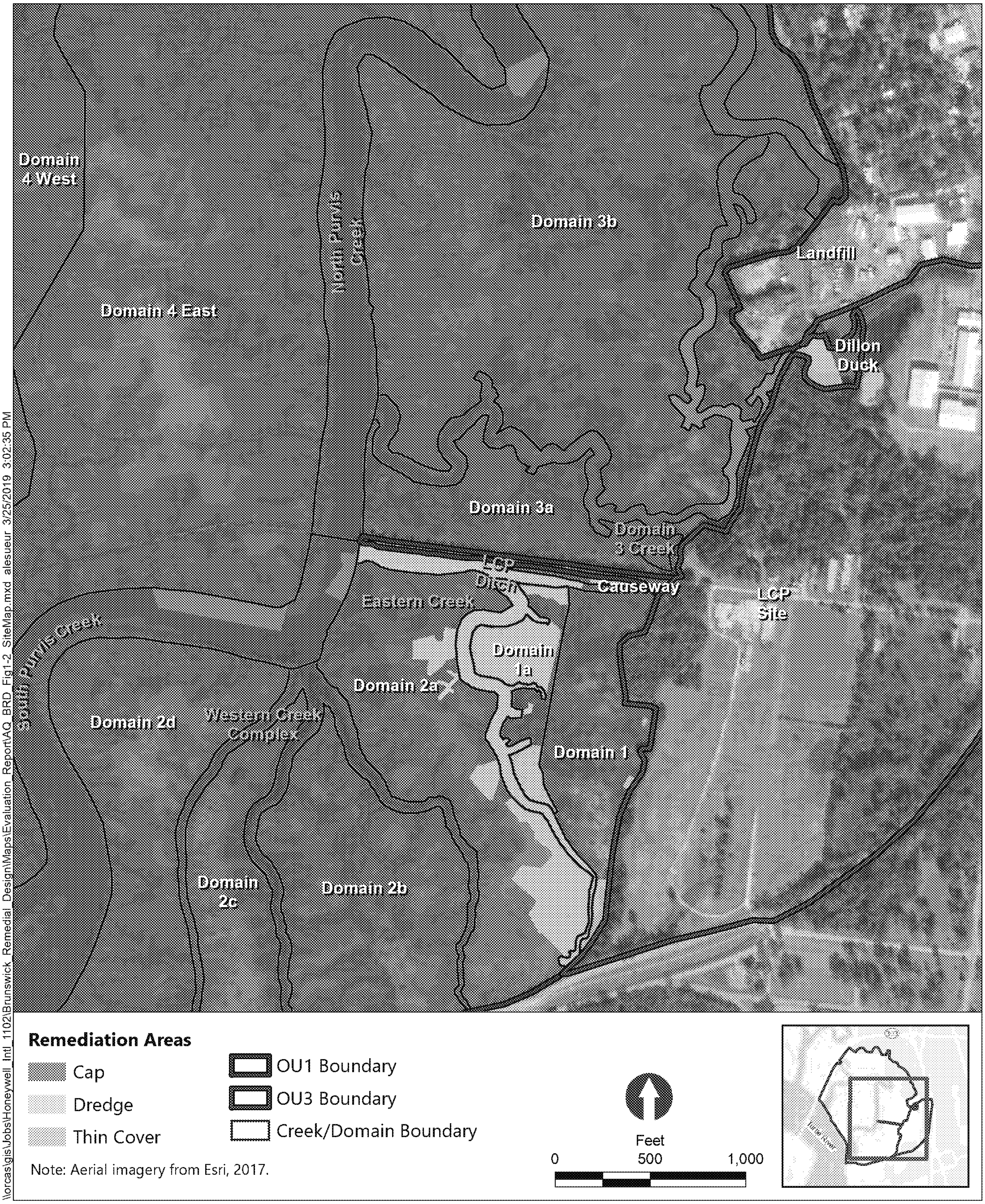


Figure 1-2
Site Map
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA

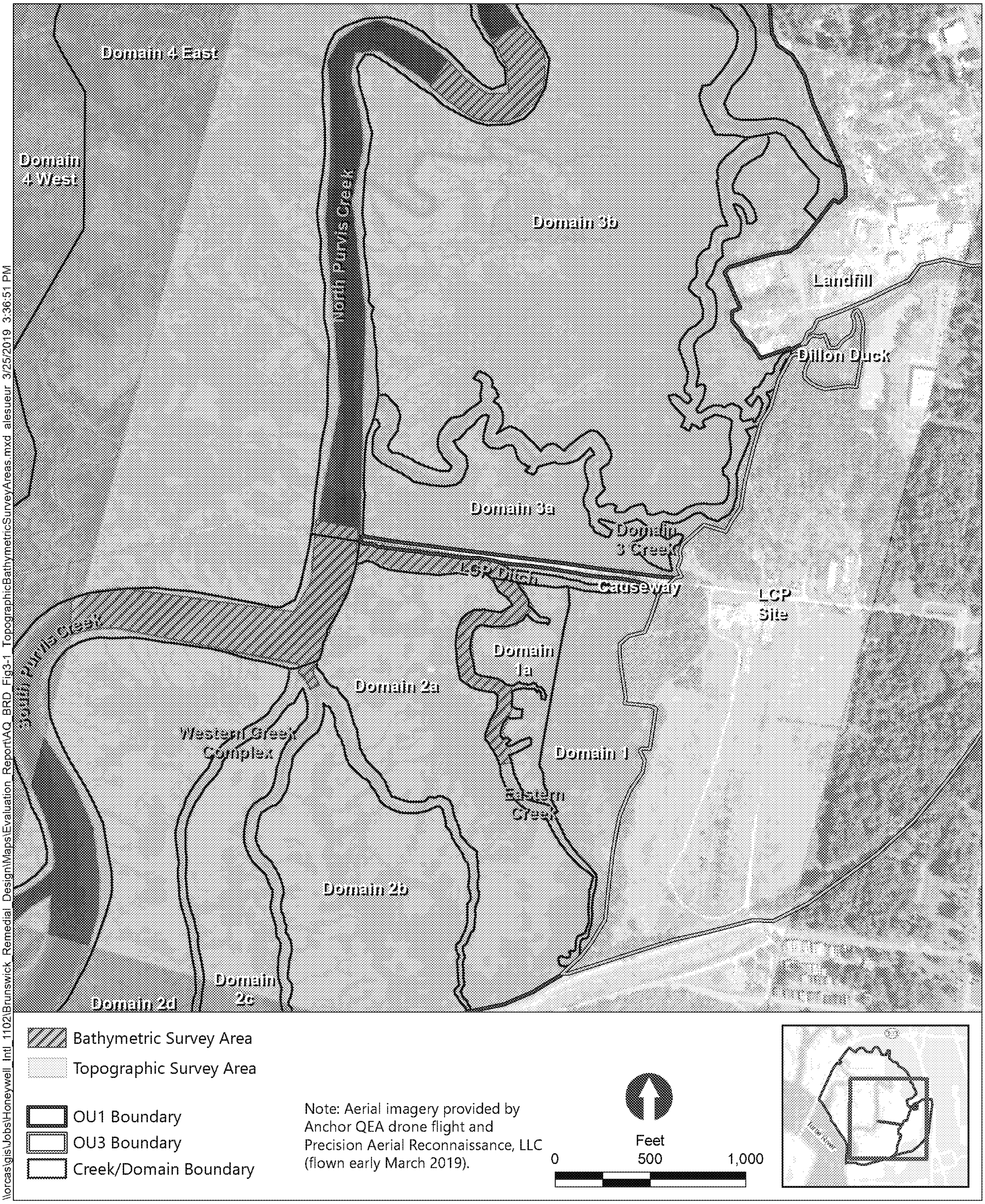
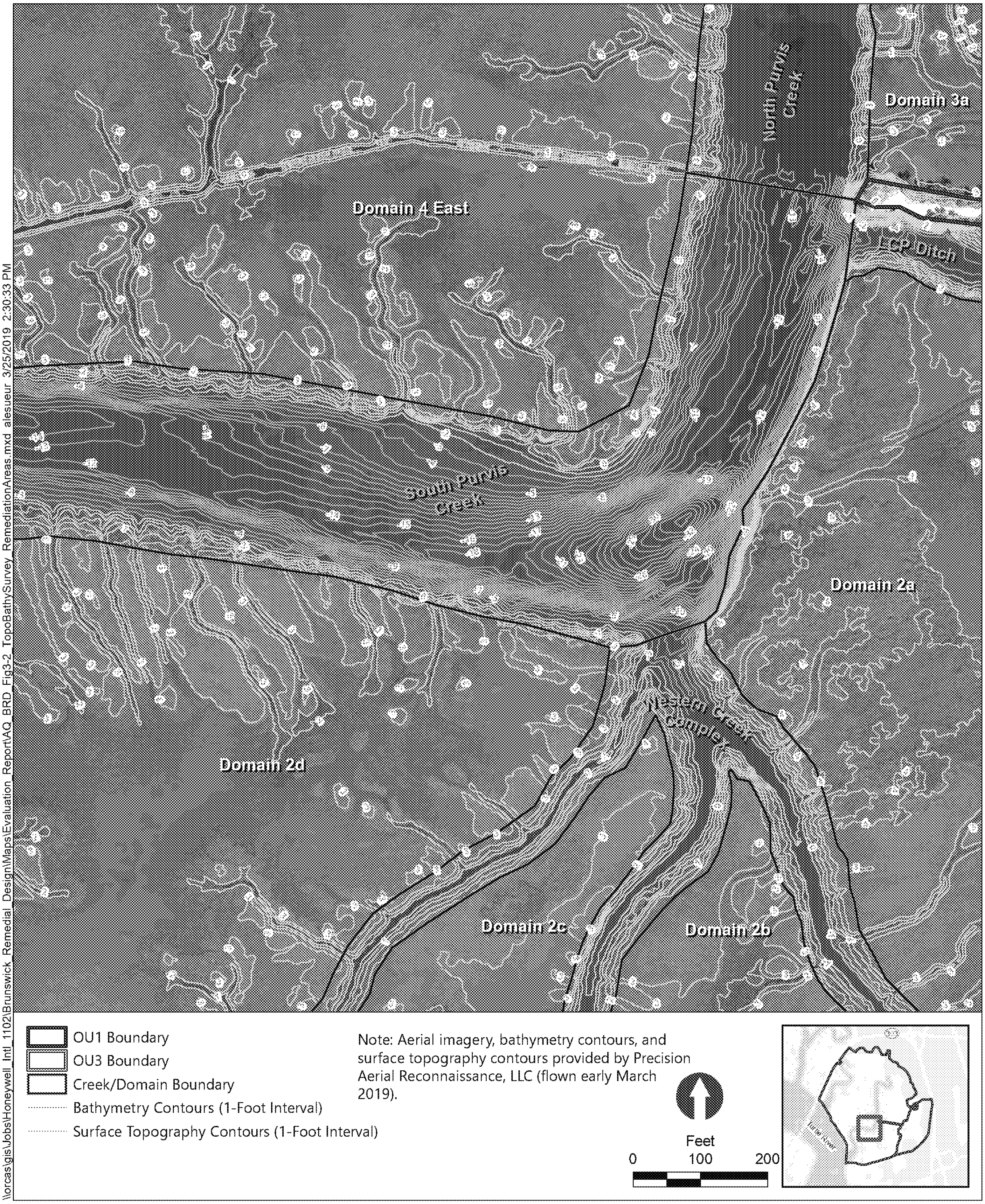


Figure 3-1
Topographic and Bathymetric Survey Areas
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA



Note: Aerial imagery, bathymetry contours, and surface topography contours provided by Precision Aerial Reconnaissance, LLC (flown early March 2019).

Figure 3-2a

Topographic and Bathymetric Survey for Remediation Areas

PDI Evaluation Report

LCP Chemicals Superfund Site

ANCHOR QEA

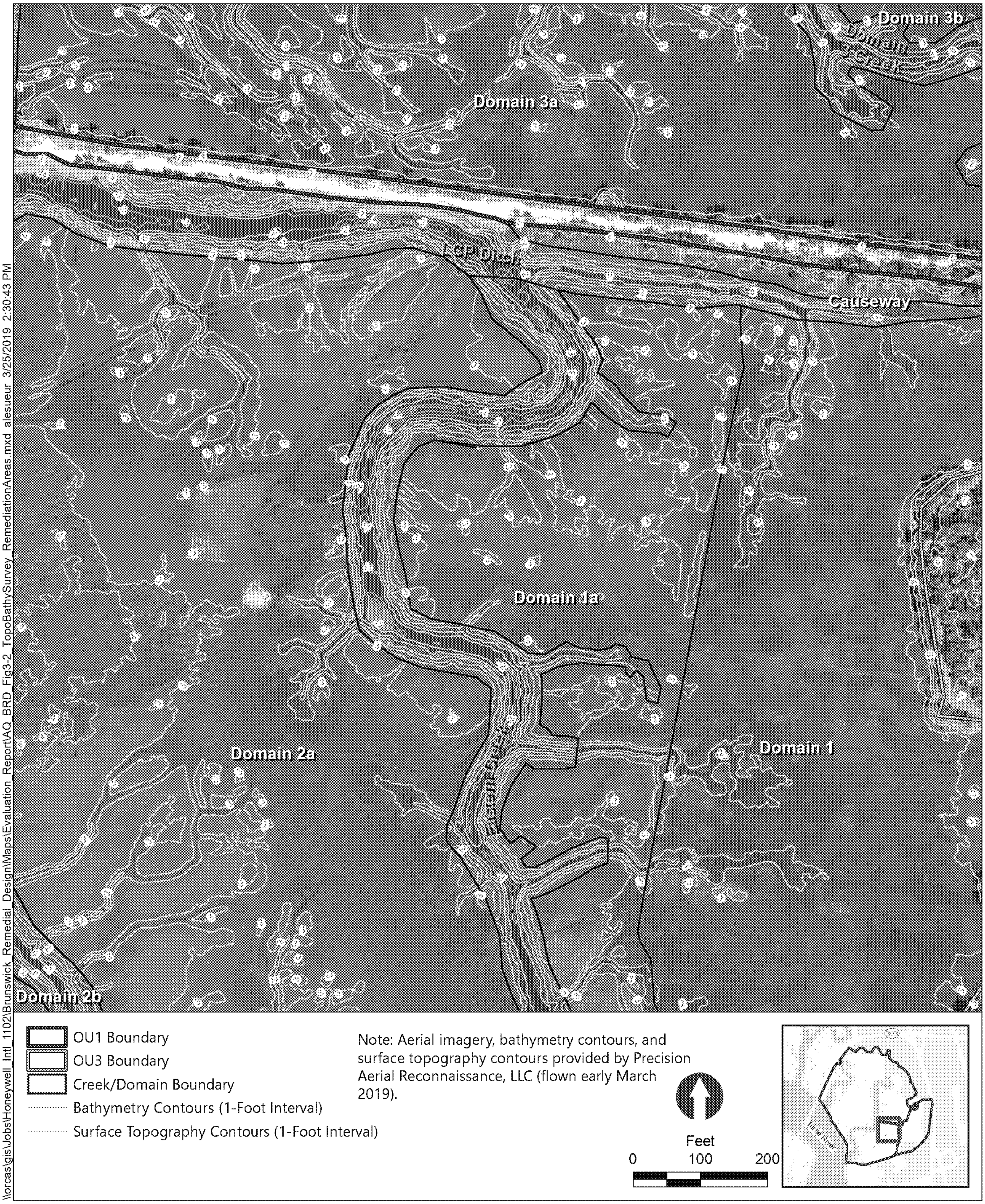


Figure 3-2b

Topographic and Bathymetric Survey for Remediation Areas

PDI Evaluation Report

LCP Chemicals Superfund Site

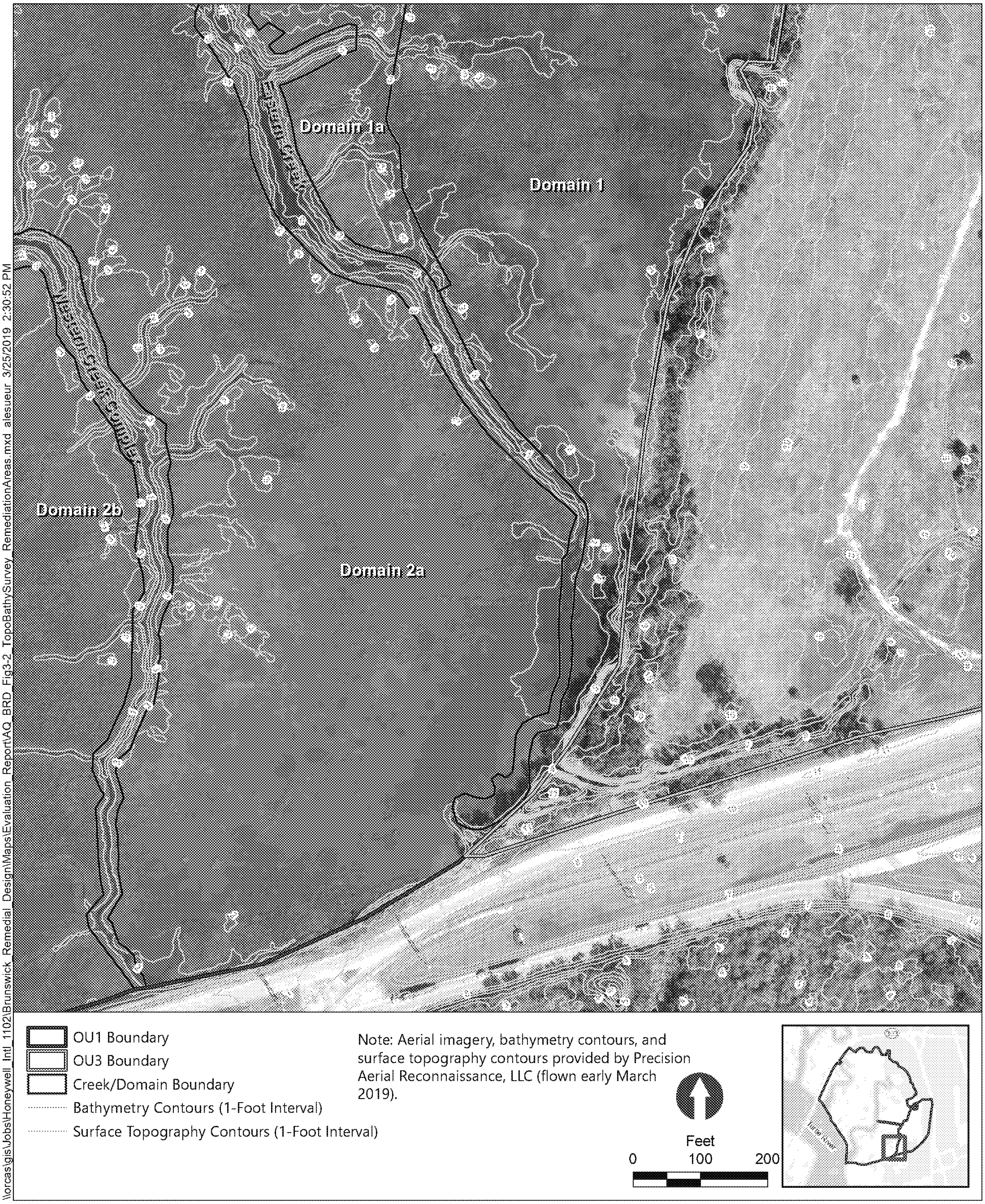


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Figure 3-2c
Topographic and Bathymetric Survey for Remediation Areas
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA

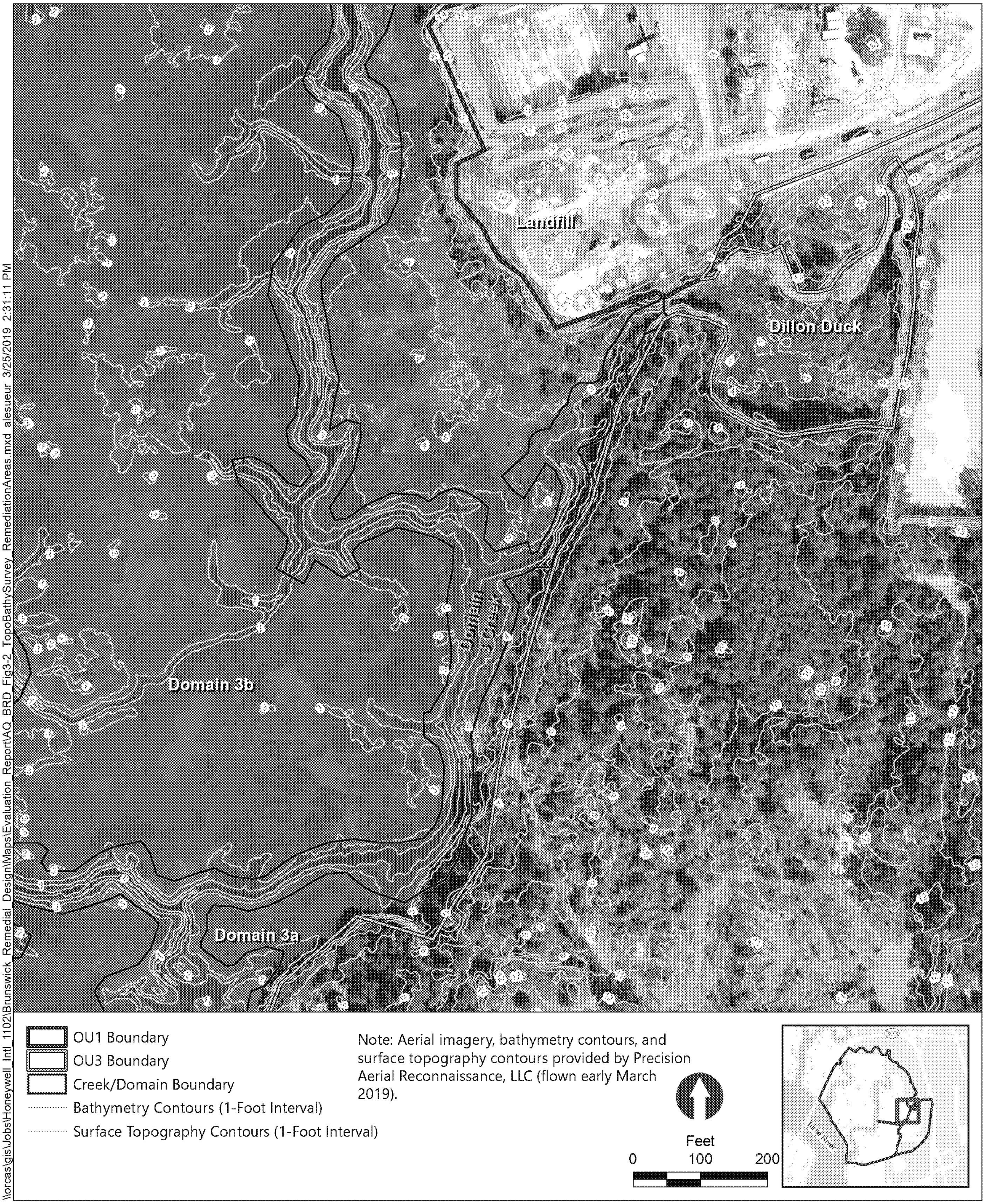

Figure 3-2d
Topographic and Bathymetric Survey for Remediation Areas
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA

OU1 Boundary
OU3 Boundary
Creek/Domain Boundary
Bathymetry Contours (1-Foot Interval)
Surface Topography Contours (1-Foot Interval)

Note: Aerial imagery, bathymetry contours, and surface topography contours provided by Precision Aerial Reconnaissance, LLC (flown early March 2019).

Feet
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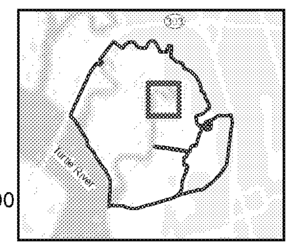


Figure 3-2e
Topographic and Bathymetric Survey for Remediation Areas
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA

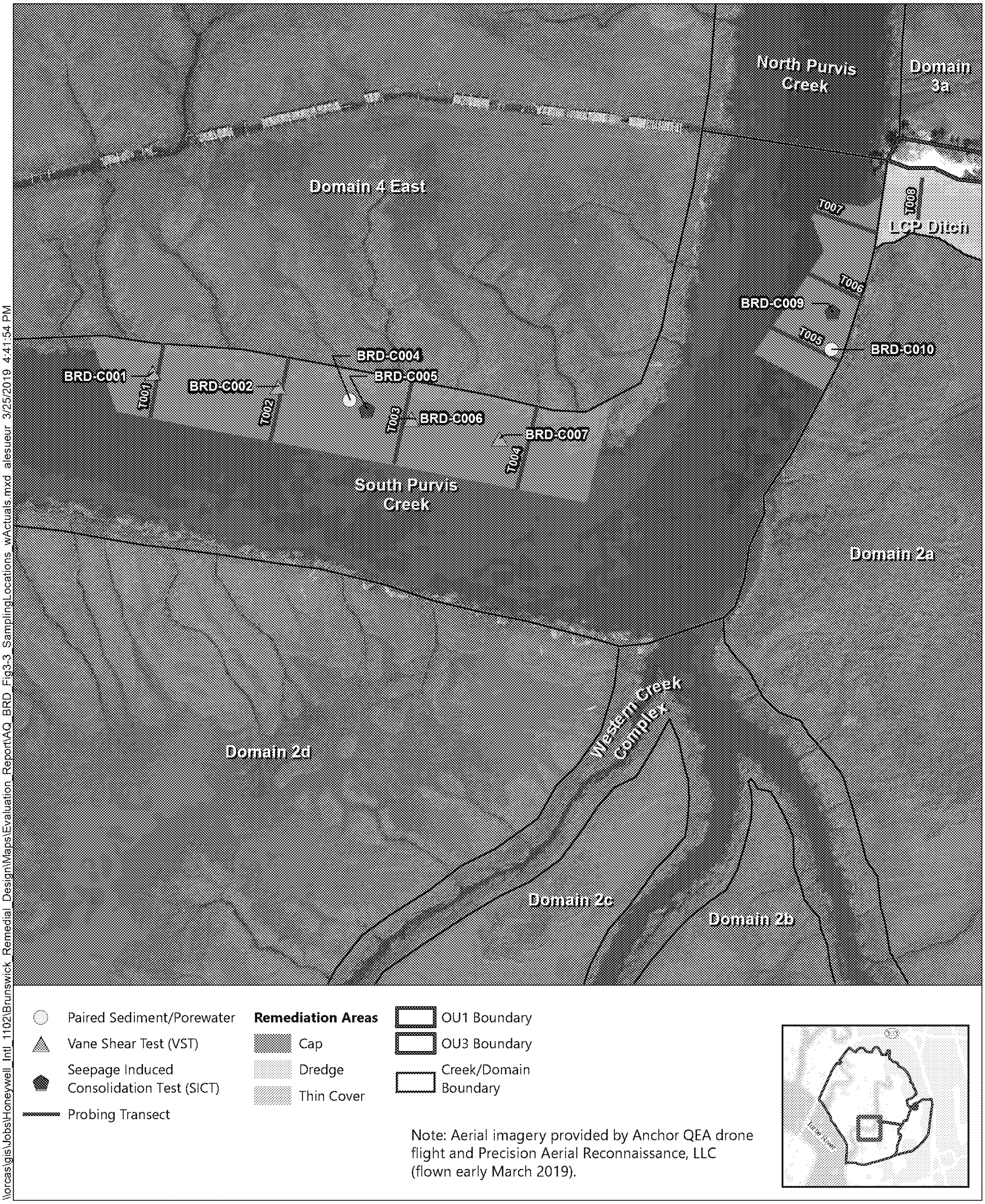


Figure 3-3a
Final PDI Sampling Locations
PDI Evaluation Report
LCP Chemicals Superfund Site

\\orcas\gis\Jobs\Honeywell Intl 1102\Brunswick Remedial Design\Maps\Evaluation Report\AQ BRD Fig3-3 SamplingLocations wActuals.mxd alesueur 3/25/2019 4:42:31 PM

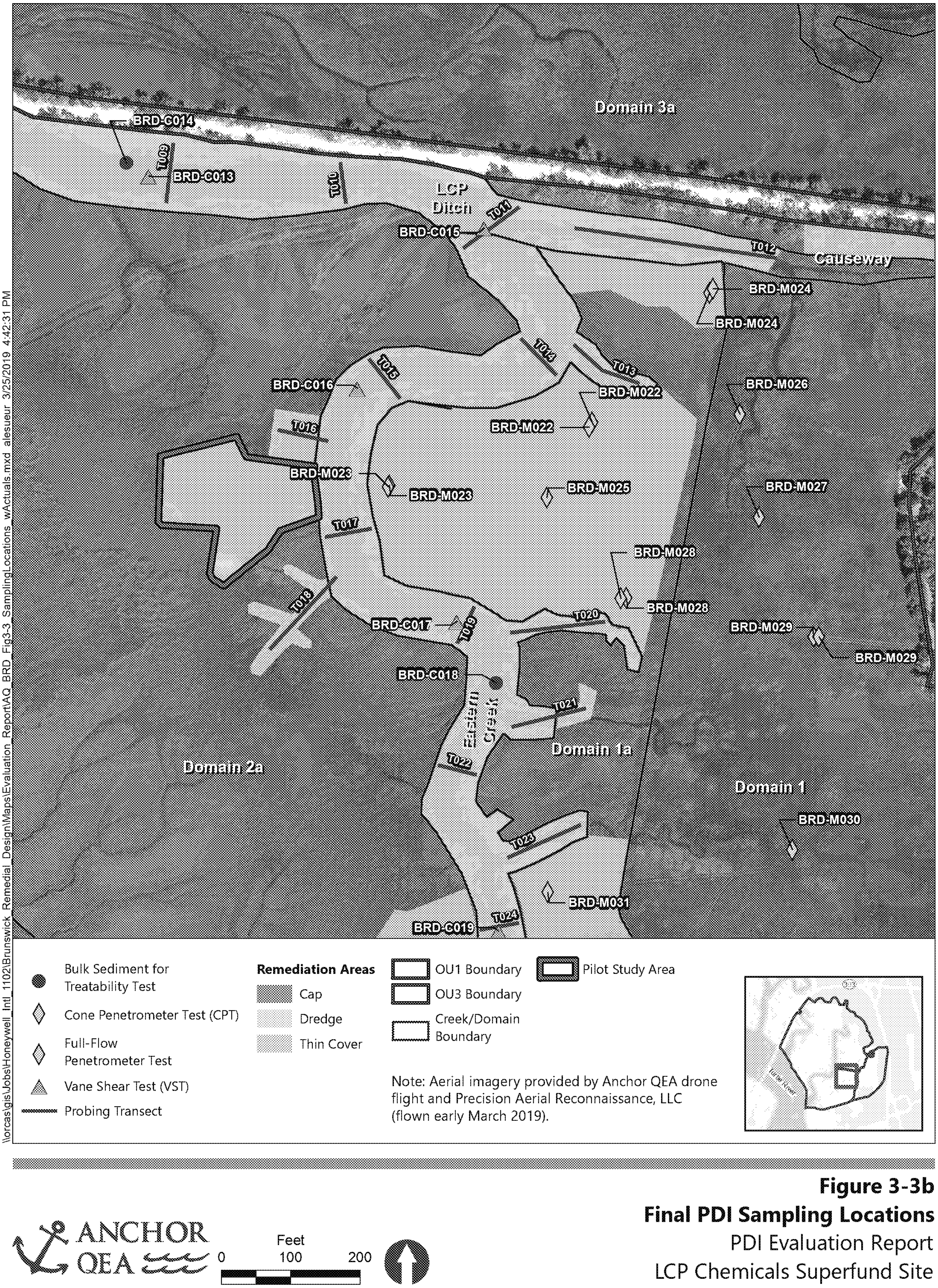
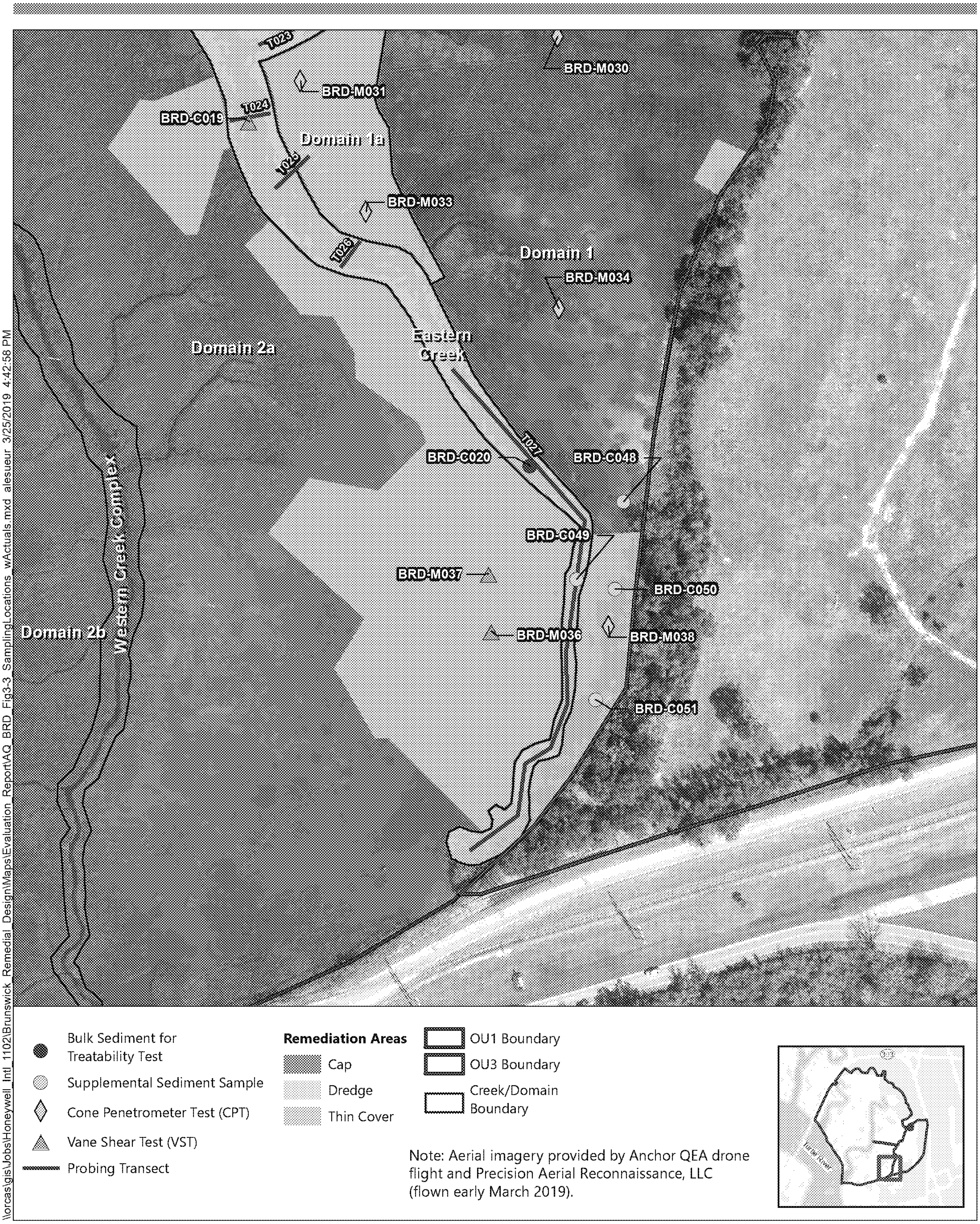


Figure 3-3b
Final PDI Sampling Locations
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA



ANCHOR QEA

Feet 0 100 200

Figure 3-3c
Final PDI Sampling Locations
PDI Evaluation Report
LCP Chemicals Superfund Site

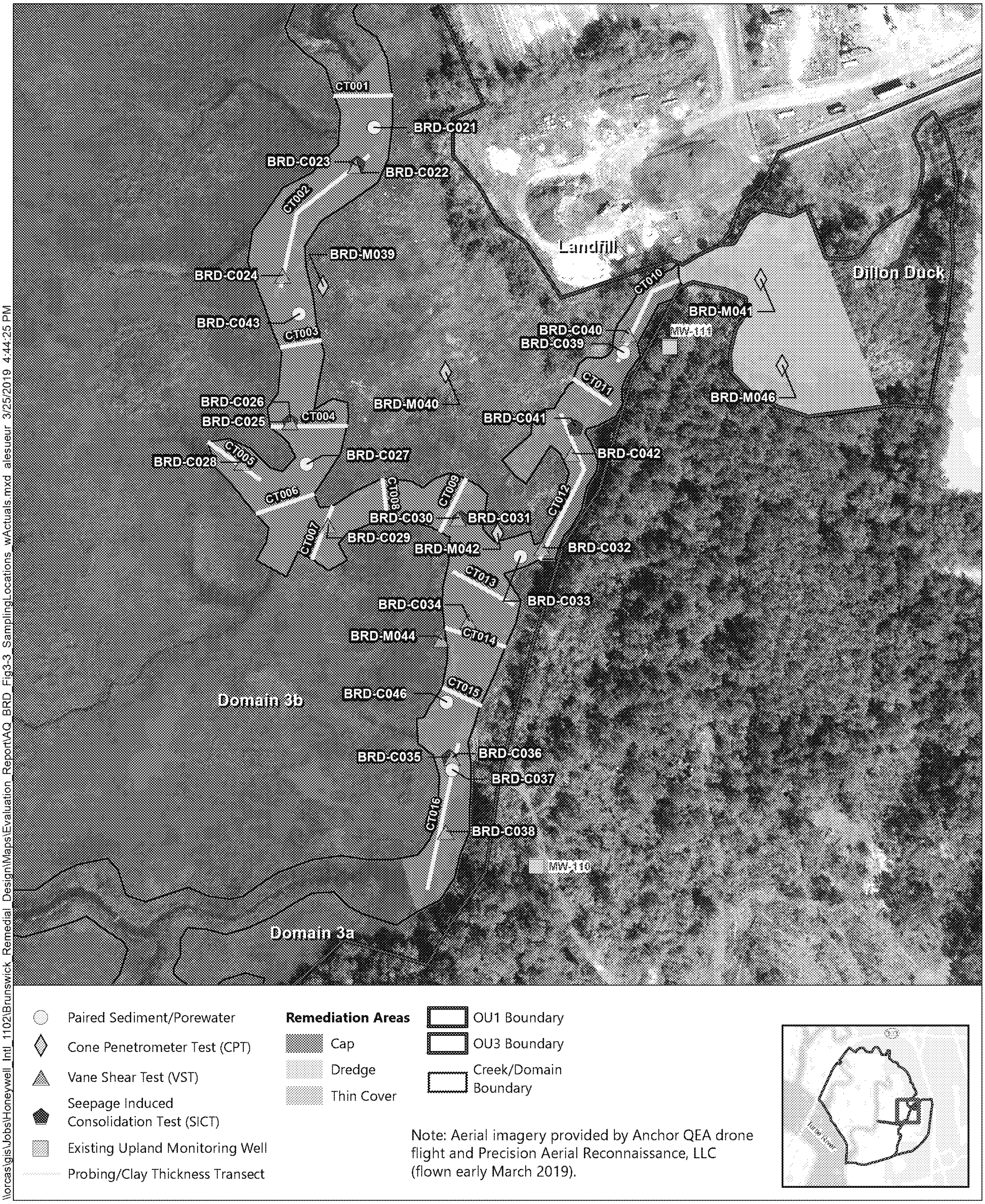


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Figure 3-3d
Final PDI Sampling Locations
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA

Feet
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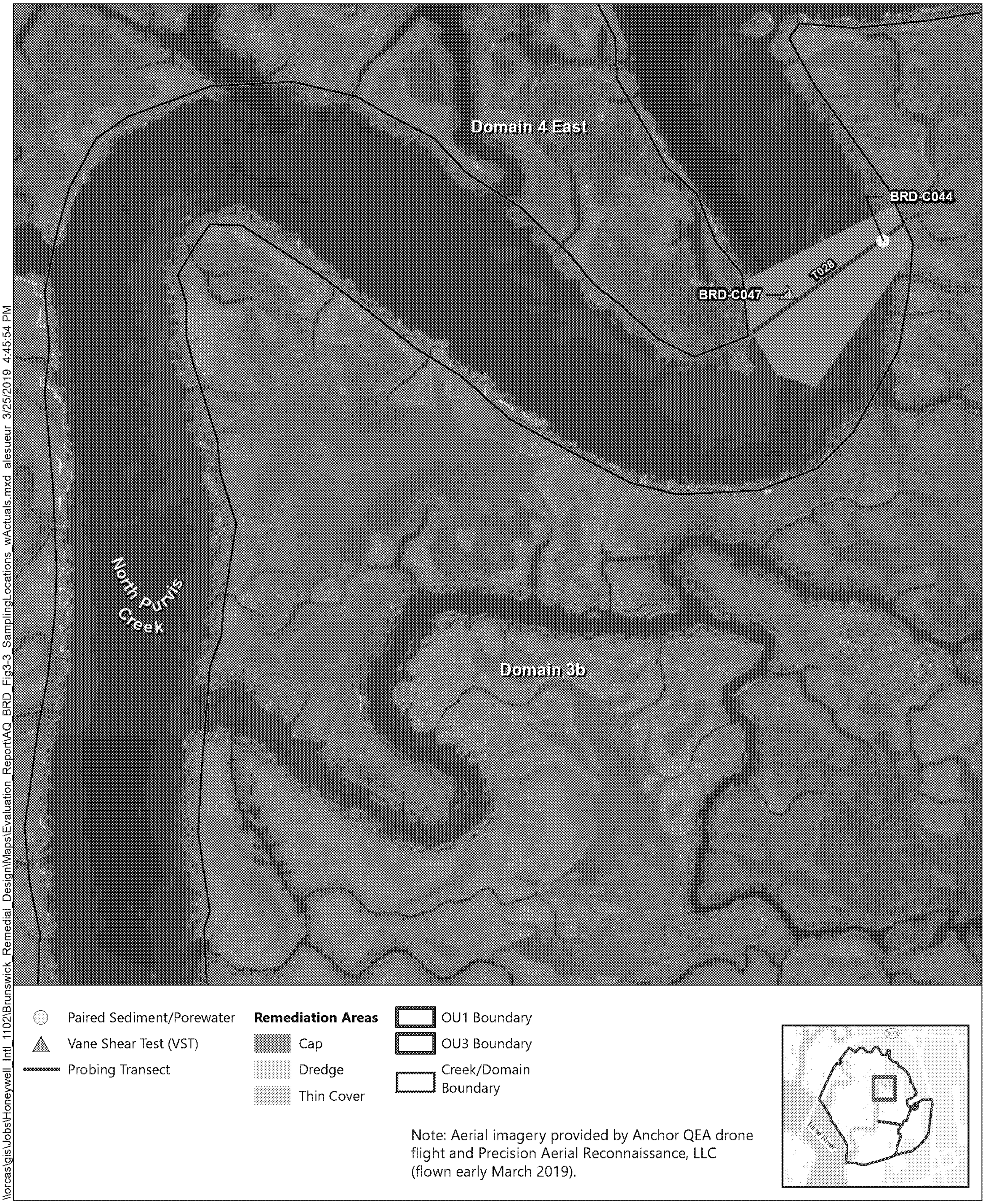
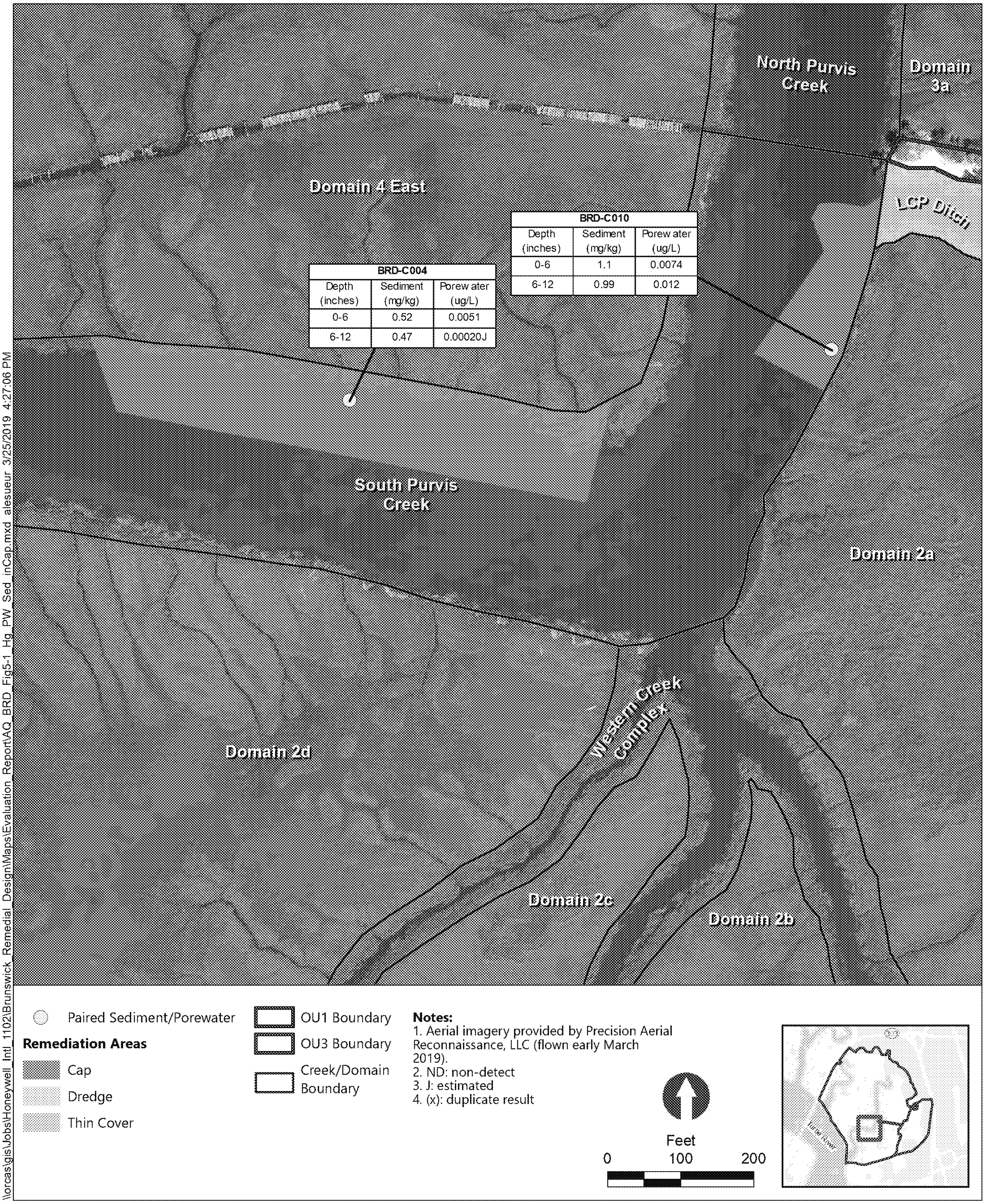


Figure 3-3e
Final PDI Sampling Locations
PDI Evaluation Report
LCP Chemicals Superfund Site



BRD-C004		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	0.52	0.0051
6-12	0.47	0.00020J

BRD-C010		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	1.1	0.0074
6-12	0.99	0.012

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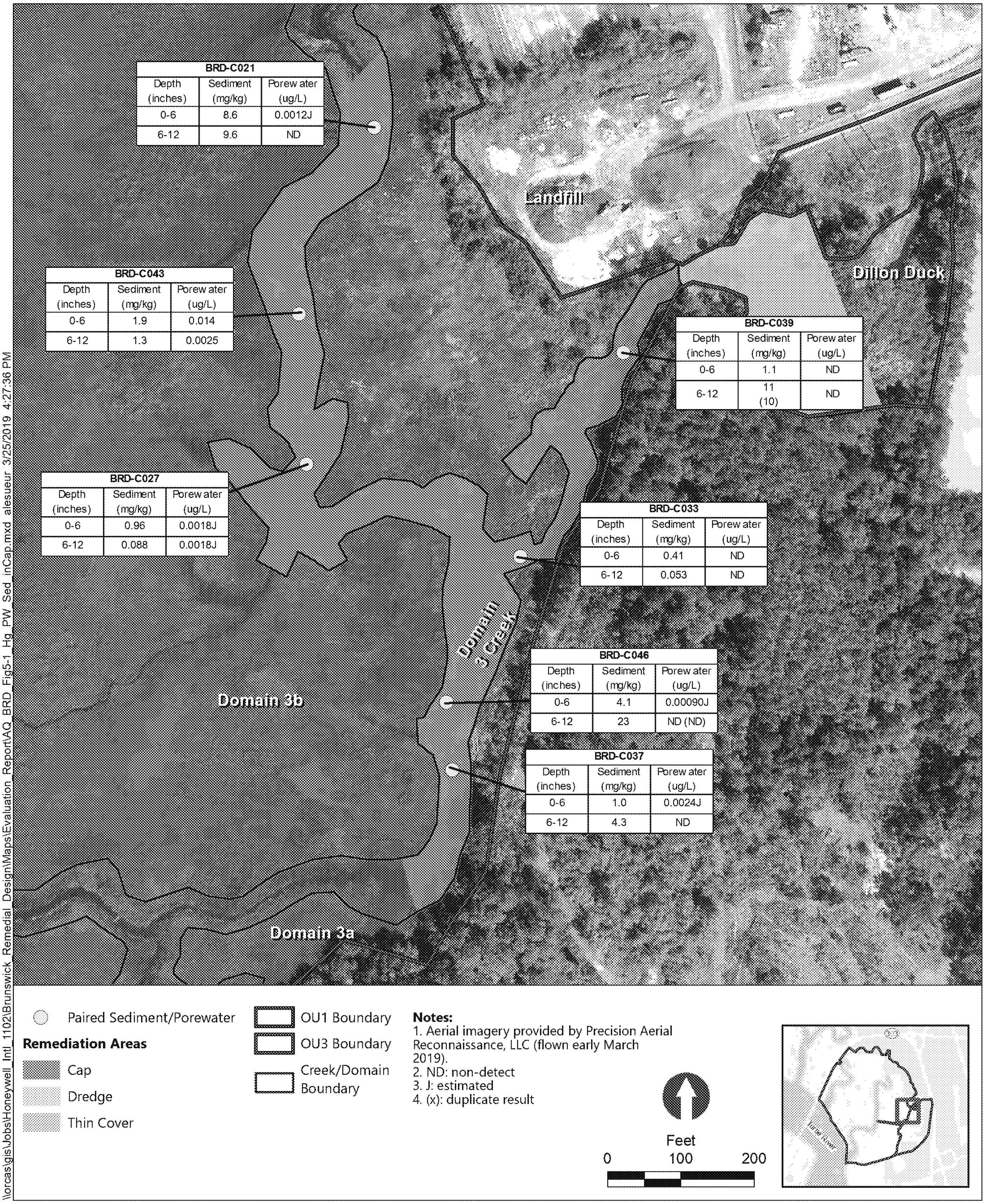
Figure 5-1a
Mercury Concentrations for Paired Sediment and Porewater Samples
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA



BRD-C021		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	8.6	0.0012J
6-12	9.6	ND

BRD-C043		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	1.9	0.014
6-12	1.3	0.0025

BRD-C027		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	0.96	0.0018J
6-12	0.088	0.0018J

BRD-C039		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	1.1	ND
6-12	11 (10)	ND

BRD-C033		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	0.41	ND
6-12	0.053	ND

BRD-C046		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	4.1	0.00090J
6-12	23	ND (ND)

BRD-C037		
Depth (inches)	Sediment (mg/kg)	Porewater (ug/L)
0-6	1.0	0.0024J
6-12	4.3	ND

Notes:
1. Aerial imagery provided by Precision Aerial Reconnaissance, LLC (flown early March 2019).
2. ND: non-detect
3. J: estimated
4. (x): duplicate result

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Figure 5-1b
Mercury Concentrations for Paired Sediment and Porewater Samples
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA

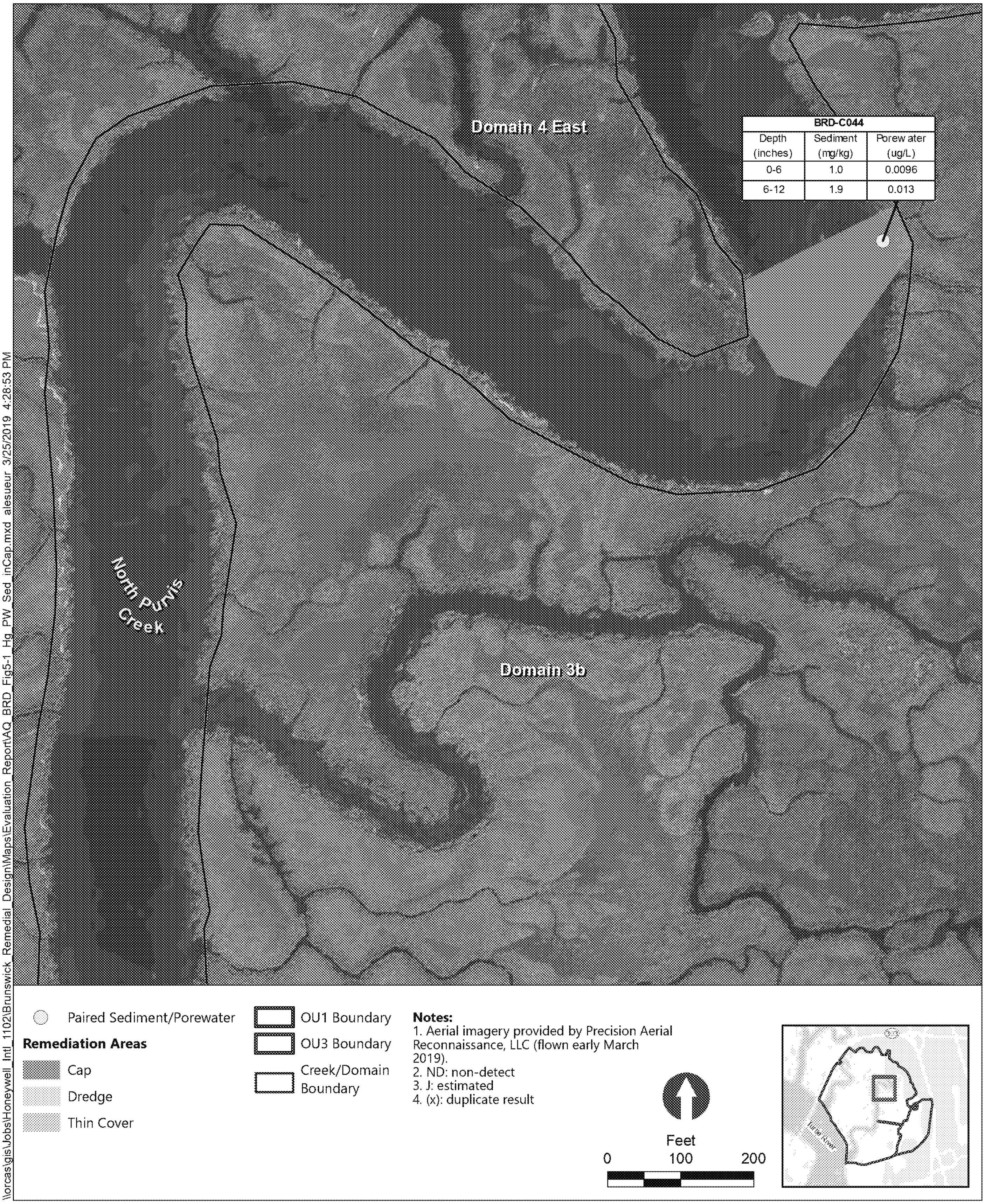

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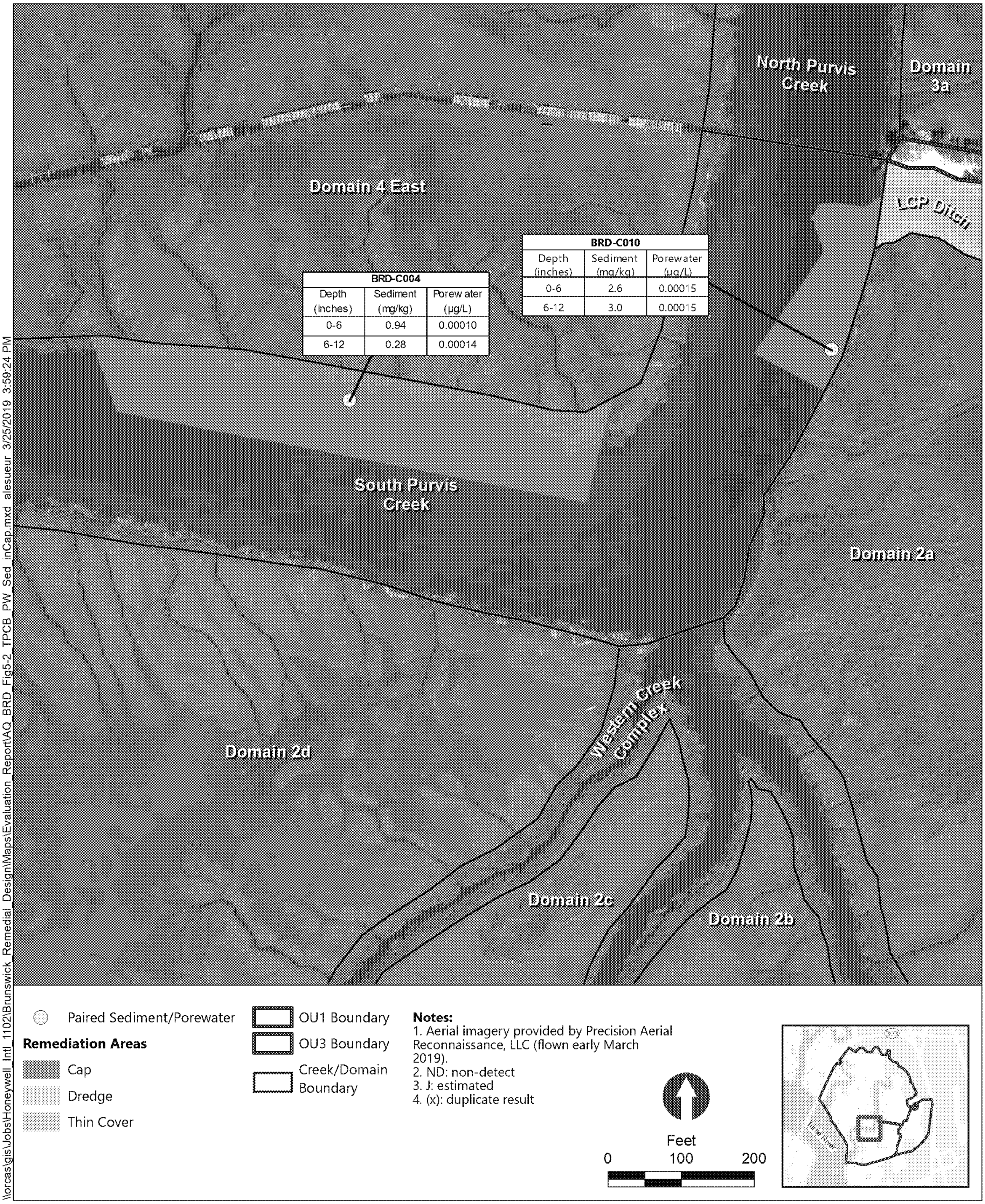
Figure 5-1c

Mercury Concentrations for Paired Sediment and Porewater Samples

PDI Evaluation Report

LCP Chemicals Superfund Site

ANCHOR QEA



Notes:
1. Aerial imagery provided by Precision Aerial Reconnaissance, LLC (flown early March 2019).
2. ND: non-detect
3. J: estimated
4. (x): duplicate result

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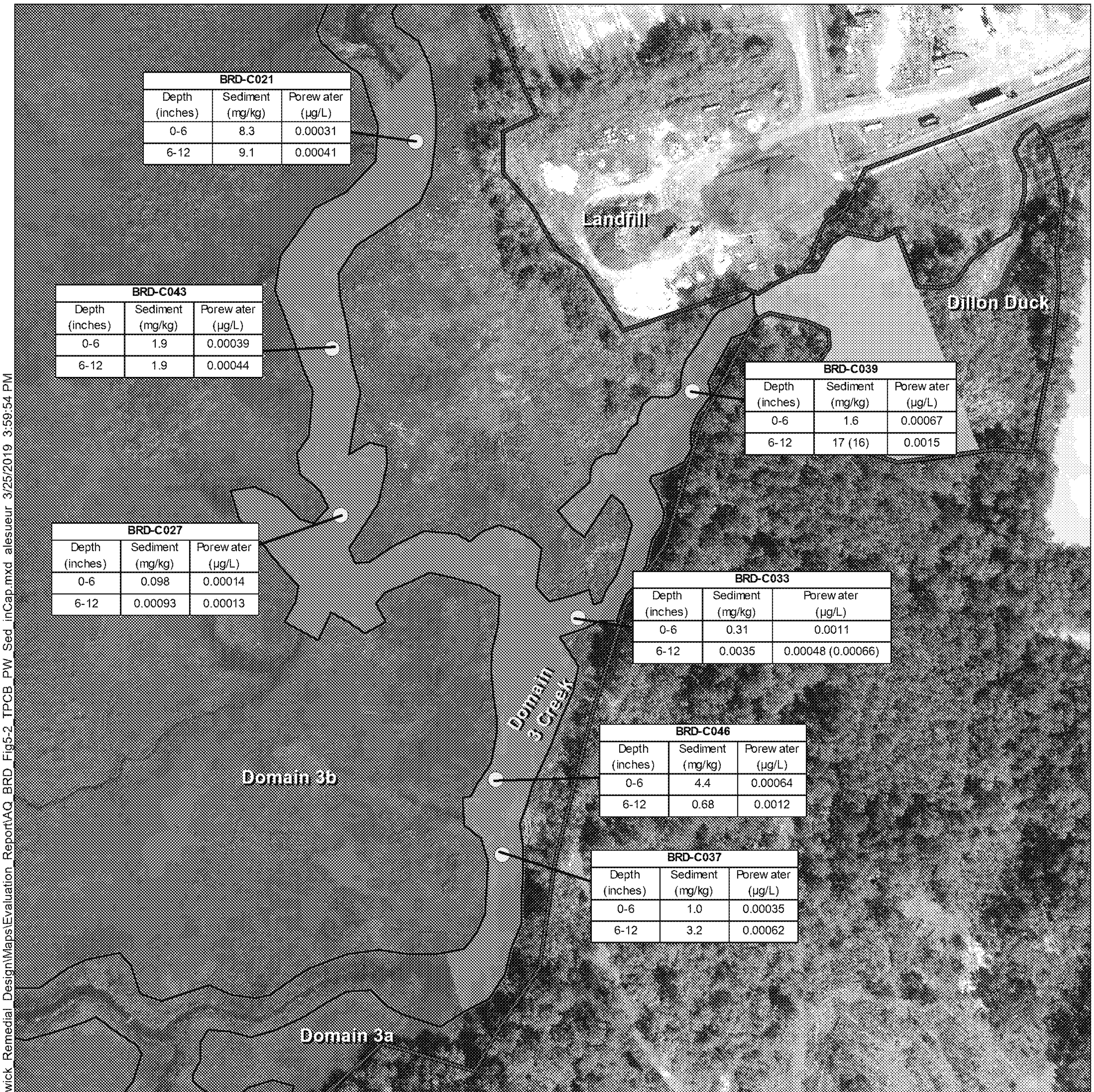
ANCHOR QEA

Figure 5-2a
Aroclor 1268 Concentrations for Paired Sediment and Porewater Samples
PDI Evaluation Report
LCP Chemicals Superfund Site



BRD-C021		
Depth (inches)	Sediment (mg/kg)	Porewater (µg/L)
0-6	8.3	0.00031
6-12	9.1	0.00041

BRD-C043		
Depth (inches)	Sediment (mg/kg)	Porewater (µg/L)
0-6	1.9	0.00039
6-12	1.9	0.00044

BRD-C039		
Depth (inches)	Sediment (mg/kg)	Porewater (µg/L)
0-6	1.6	0.00067
6-12	17 (16)	0.0015

BRD-C027		
Depth (inches)	Sediment (mg/kg)	Porewater (µg/L)
0-6	0.098	0.00014
6-12	0.00093	0.00013

BRD-C033		
Depth (inches)	Sediment (mg/kg)	Porewater (µg/L)
0-6	0.31	0.0011
6-12	0.0035	0.00048 (0.00066)

BRD-C046		
Depth (inches)	Sediment (mg/kg)	Porewater (µg/L)
0-6	4.4	0.00064
6-12	0.68	0.0012

BRD-C037		
Depth (inches)	Sediment (mg/kg)	Porewater (µg/L)
0-6	1.0	0.00035
6-12	3.2	0.00062

Paired Sediment/Porewater

Remediation Areas

Cap

Dredge

Thin Cover

OU1 Boundary

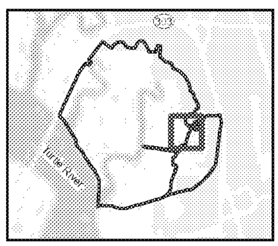
OU3 Boundary

Creek/Domain Boundary

Notes:
1. Aerial imagery provided by Precision Aerial Reconnaissance, LLC (flown early March 2019).
2. ND: non-detect
3. J: estimated
4. (x): duplicate result

Feet

0 100 200



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ANCHOR QEA

Figure 5-2b

Aroclor 1268 Concentrations for Paired Sediment and Porewater Samples

PDI Evaluation Report

LCP Chemicals Superfund Site

BRD-C044		
Depth (inches)	Sediment (mg/kg)	Porewater (µg/L)
0-6	1.8	0.00023
6-12	4.3	0.00015

Paired Sediment/Porewater

Remediation Areas

Cap

Dredge

Thin Cover

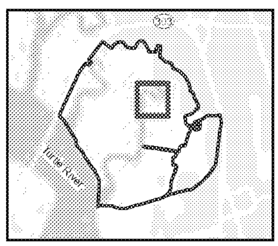
OU1 Boundary

OU3 Boundary

Creek/Domain Boundary

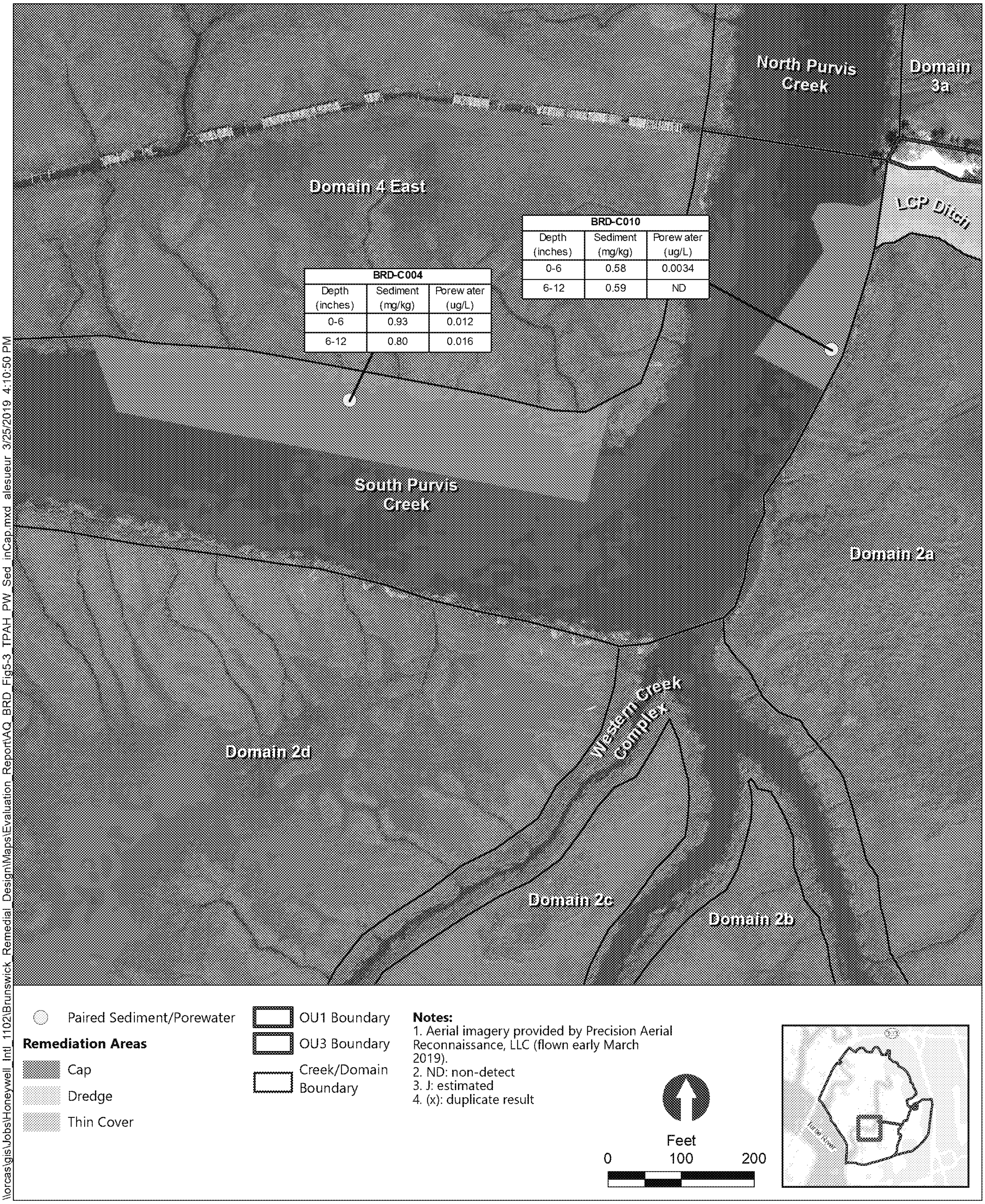
Notes:
1. Aerial imagery provided by Precision Aerial Reconnaissance, LLC (flown early March 2019).
2. ND: non-detect
3. J: estimated
4. (x): duplicate result

Feet
0 100 200



ANCHOR QEA

Figure 5-2c
Aroclor 1268 Concentrations for Paired Sediment and Porewater Samples
PDI Evaluation Report
LCP Chemicals Superfund Site



BRD-C004

Depth (inches)	Sediment (mg/kg)	Porew ater (ug/L)
0-6	0.93	0.012
6-12	0.80	0.016

BRD-C010

Depth (inches)	Sediment (mg/kg)	Porew ater (ug/L)
0-6	0.58	0.0034
6-12	0.59	ND

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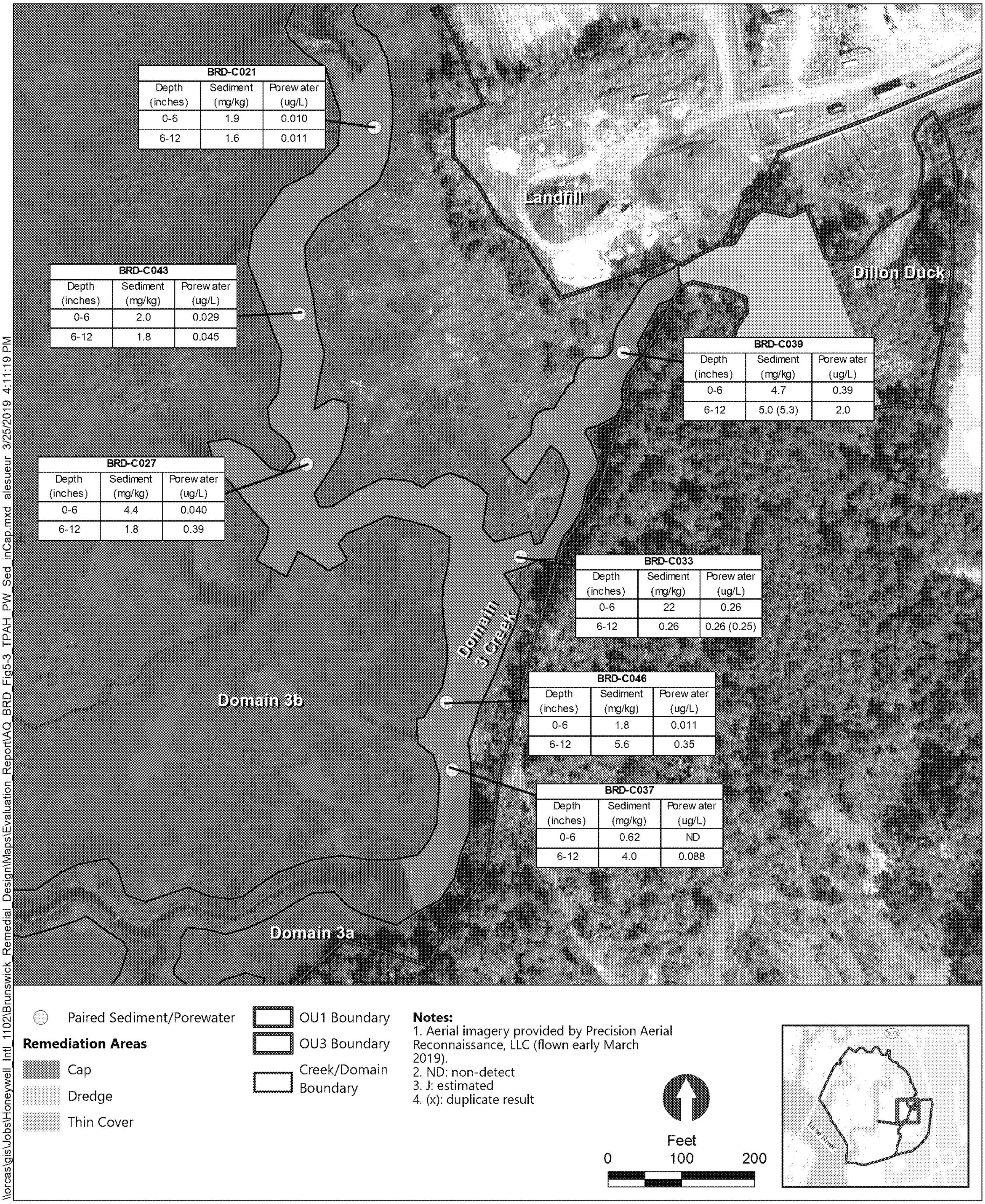
ANCHOR QEA

Figure 5-3a
TPAH Concentrations for Paired Sediment and Porewater Samples
PDI Evaluation Report
LCP Chemicals Superfund Site



\\orcas\gis\Jobs\Honeywell_Intl_1102\Brunswick_Remedial_Design\Maps\Evaluation_Report\AQ_BRD_Fig5-3_TPAH_PW_Sed_inCap.mxd alesueur 3/25/2019 4:11:19 PM

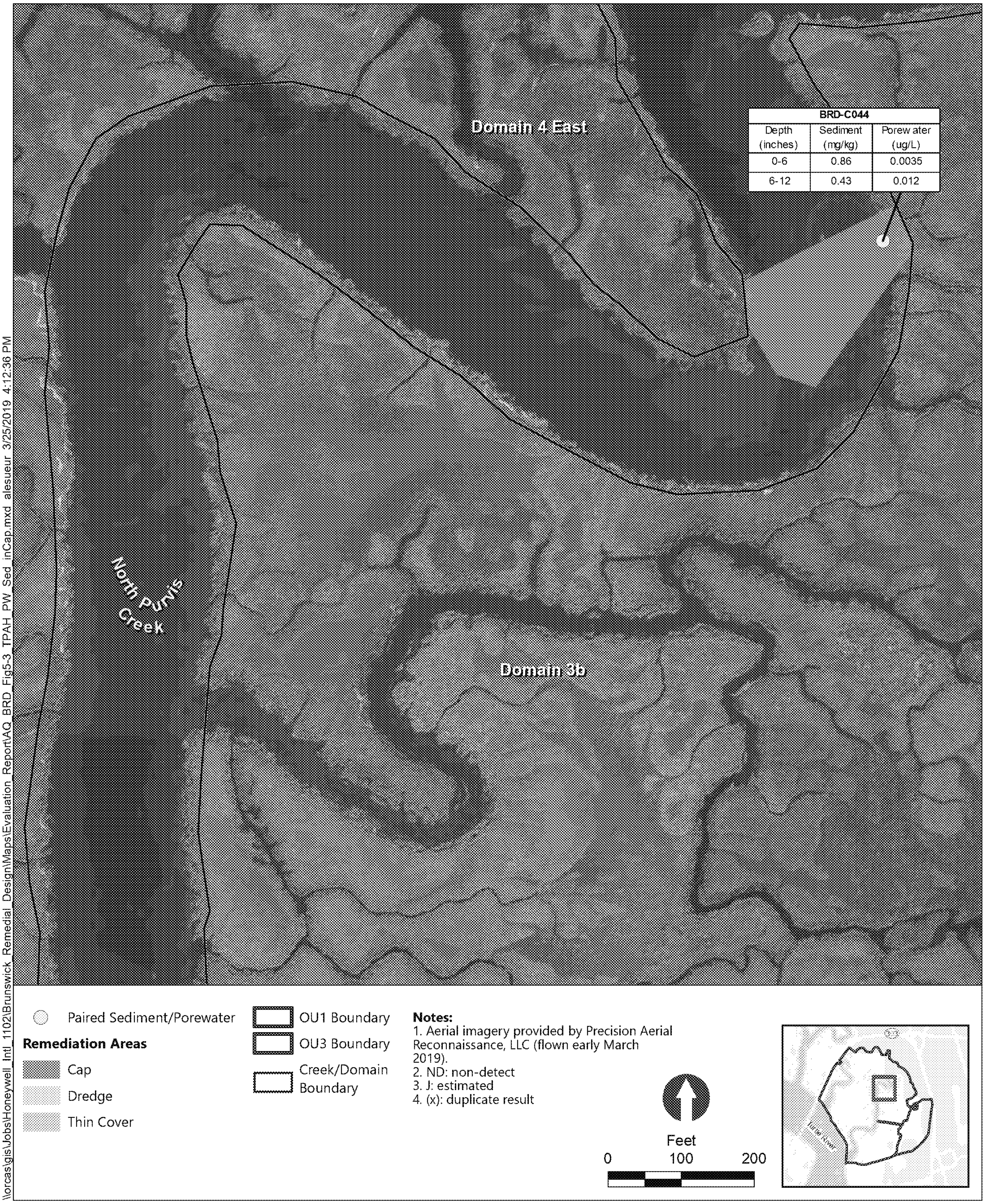
Figure 5-3b

TPAH Concentrations for Paired Sediment and Porewater Samples

PDI Evaluation Report

LCP Chemicals Superfund Site

ANCHOR QEA



BRD-C044		
Depth (inches)	Sediment (mg/kg)	Porew ater (ug/L)
0-6	0.86	0.0035
6-12	0.43	0.012

Notes:
1. Aerial imagery provided by Precision Aerial Reconnaissance, LLC (flown early March 2019).
2. ND: non-detect
3. J: estimated
4. (x): duplicate result

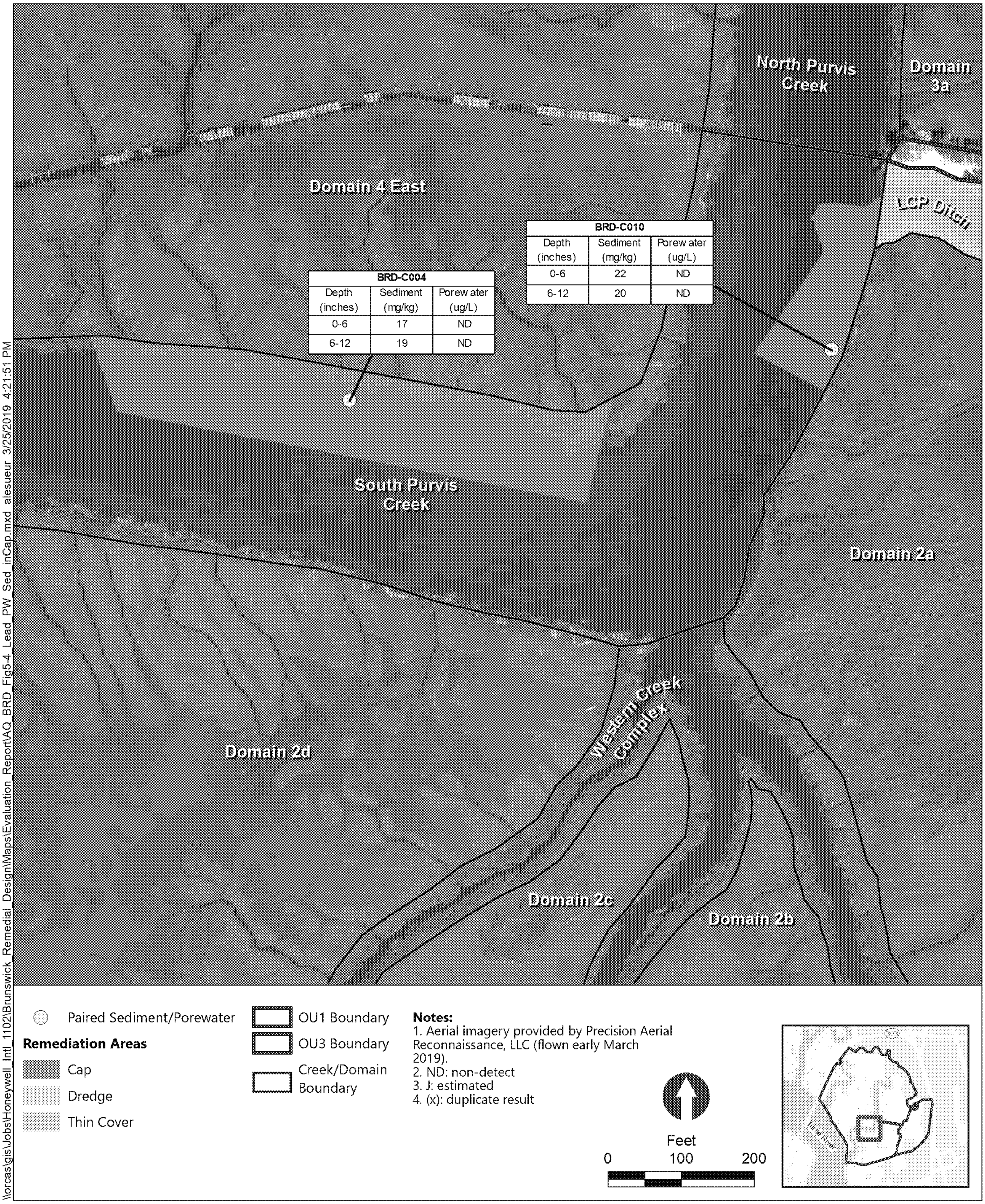
Figure 5-3c

TPAH Concentrations for Paired Sediment and Porewater Samples

PDI Evaluation Report

LCP Chemicals Superfund Site

ANCHOR QEA



\\orcas\gis\Jobs\Honeywell_Intl_1102\Brunswick_Remedial_Design\Maps\Evaluation_Report\AQ_BRD_Fig5-4_Lead_PW_Sed_inCap.mxd alesueur 3/25/2019 4:21:51 PM

Figure 5-4a

Lead Concentrations for Paired Sediment and Porewater Samples

PDI Evaluation Report

LCP Chemicals Superfund Site

ANCHOR QEA

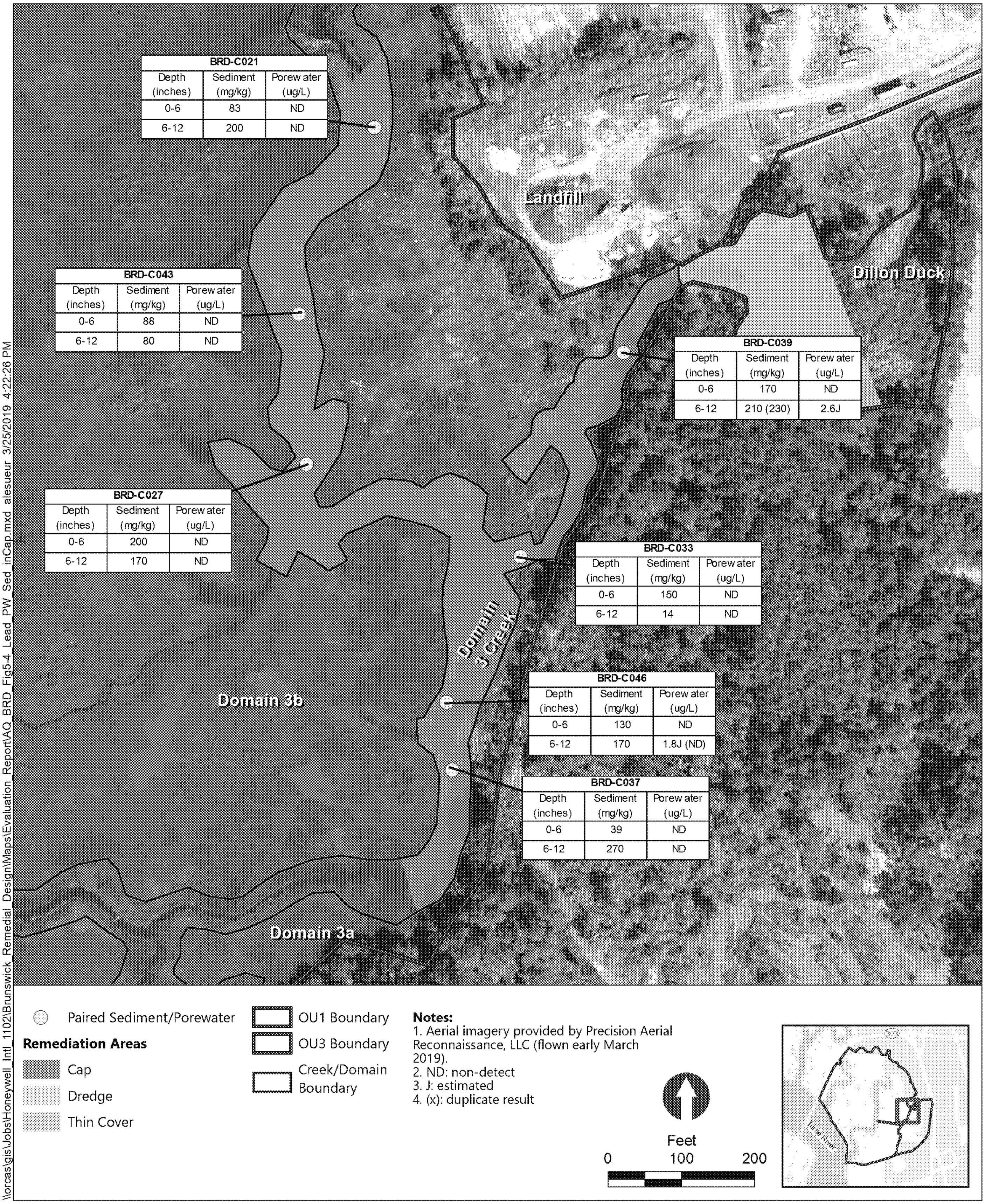
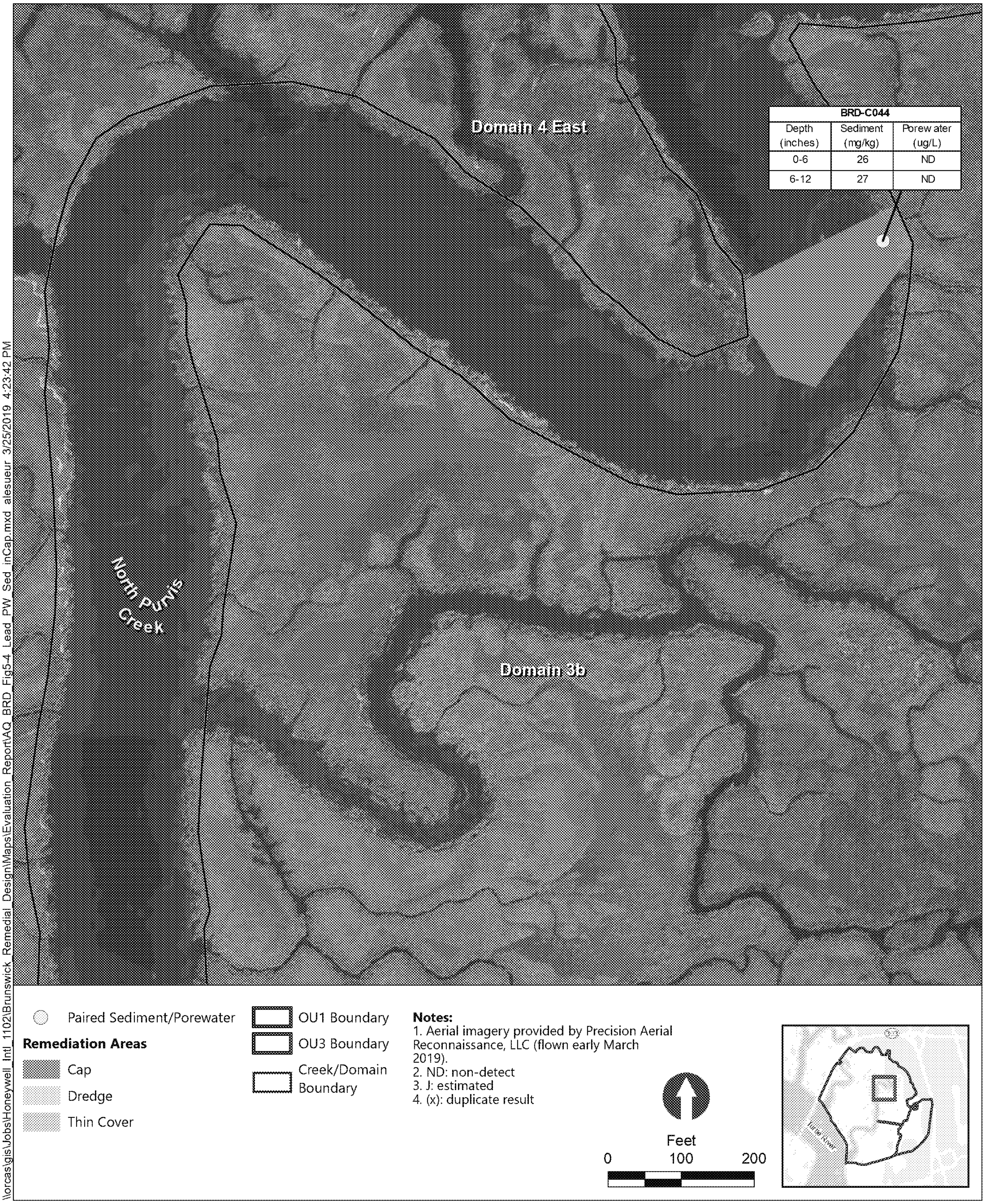


Figure 5-4b
Lead Concentrations for Paired Sediment and Porewater Samples
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA

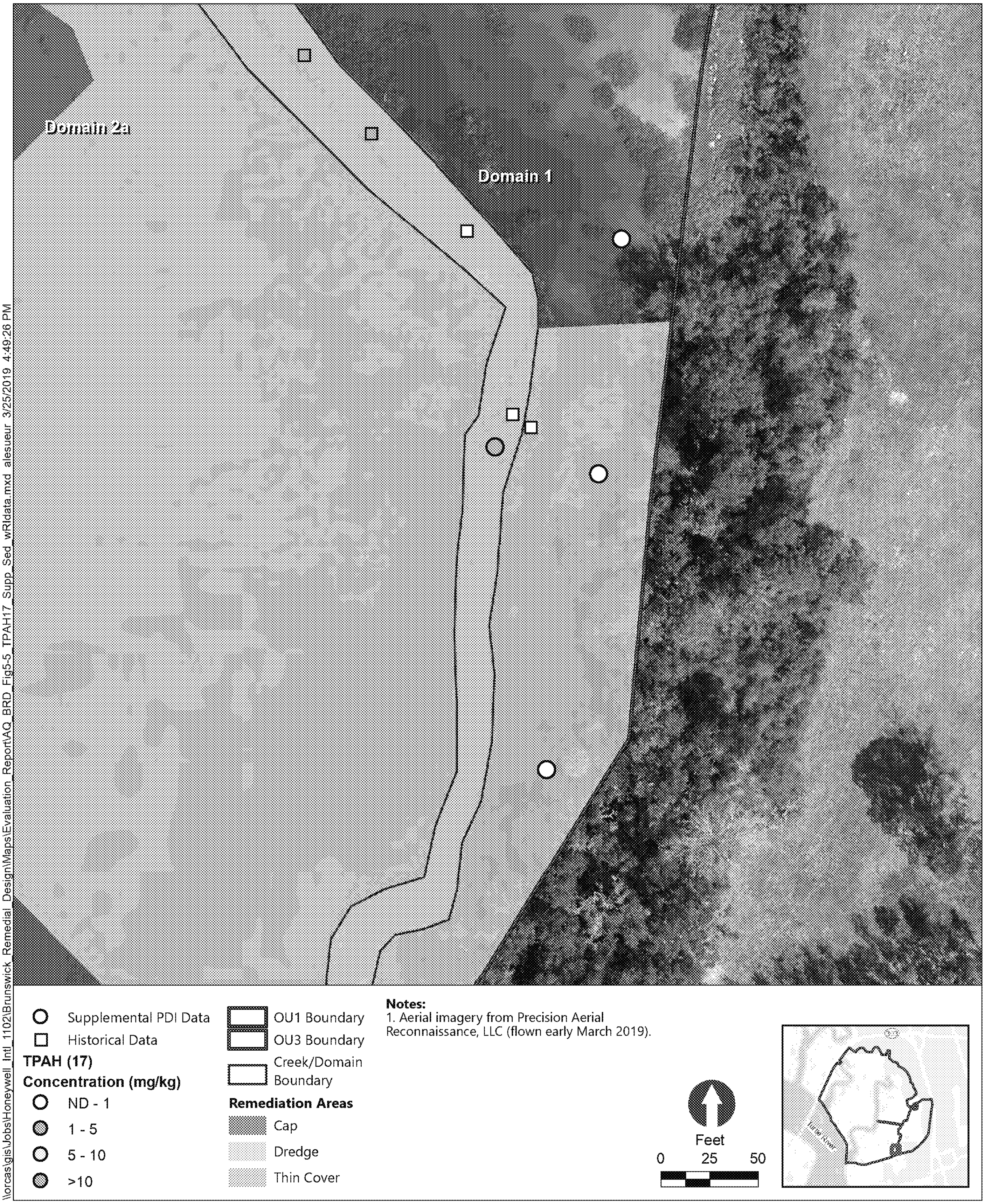


BRD-C044		
Depth (inches)	Sediment (mg/kg)	Porew ater (ug/L)
0-6	26	ND
6-12	27	ND

Notes:
1. Aerial imagery provided by Precision Aerial Reconnaissance, LLC (flown early March 2019).
2. ND: non-detect
3. J: estimated
4. (x): duplicate result

Figure 5-4c
Lead Concentrations for Paired Sediment and Porewater Samples
PDI Evaluation Report
LCP Chemicals Superfund Site

ANCHOR QEA



Notes:
1. Aerial imagery from Precision Aerial Reconnaissance, LLC (flown early March 2019).

Figure 5-5

TPAH Concentration for Supplemental PDI Sample Locations

PDI Evaluation Report
LCP Chemicals Superfund Site

Appendix A
Topographic and Bathymetric Survey Data Report

Appendix B
Cone Penetrometer Testing Results

Appendix C
Seepage Induced Consolidation Test Results

Appendix D
Geotechnical Sampling Laboratory Reports

Appendix E
Treatability Study Report

Appendix F
Data Validation and Laboratory Reports

Appendix G
Photolog of PDI Program